INSTRUCTION MANUAL

SULTAN
Acoustic Wave Series
- Level, Flow, Positioning, Collision Protection -

A higher level of performance
CONTENTS

PROPRIETARY NOTICE
The information contained in this publication is derived in part from proprietary and patent data. This information has been prepared for the express purpose of assisting operating and maintenance personnel in the efficient use of the instrument described herein. Publication of this information does not convey any rights to use or reproduce it, or to use for any purpose other than in connection with the installation, operation and maintenance of the equipment described herein.

WARNING
This instrument contains electronic components that are susceptible to damage by static electricity. Proper handling procedures must be observed during the removal, installation, or handling of internal circuit boards or devices:

Handling Procedure:
1. Power to unit must be removed prior to commencement of any work.
2. Personnel must be grounded, via wrist strap or other safe, suitable means, before any printed circuit board or other internal devices are installed, removed or adjusted.
3. Printed circuit boards must be transported in a conductive bag or other conductive container. Boards must not be removed from protective container until the immediate time of installation. Removed boards must be placed immediately in a protective container for transport, storage, or return to factory.

Comments:
This instrument is not unique in its content of ESD (electrostatic discharge) sensitive components. Most modern electronic designs contain components that utilize metal oxide technology (NMOS, CMOS, etc.). Experience has proven that even small amounts of static electricity can damage or destroy these devices. Damaged components, even though they appear to function properly, exhibit early failure.

Section References

General Description, Features 2
Typical Applications 3
Application References 4
Dimensions 8
- Smart, Integral, Remote Units
- Suggested Mounting Dimensions
Mounting 12
- Typical Installations
- Installation Guide
- Open Channel Flow
Wiring 18
- Terminal Layouts
- Remote Transducers
- 4-20mA output
- Relay Functions
- Cross Talk Prevention
- Multidrop Connections
- 2 Wire Unit Communications
- HawkLink GSM
- Test Terminal
- Lightning Protection
Setup Procedure 44
- Level Measurement
- Average Level
- Differential Level
- Open Channel Flow
- Positioning Measurement
- Gain Adjustment
- Recover Adjustment
- Setting the System
- Special Application Setup Examples
Software Menus 63
- Entering Data
- Software Tree
- Volume Adjustment
- Quickset
- Transducer Setup
- Output Adjustment
- Comms
Advanced menus 78
- Tracking
- Differential Level
- Factory
Diagnostic Displays 80
Error codes
Sultan Safety Instructions 82
Part Numbering 91
Specifications 97
Sound Velocity Table 99
CE Declaration & Certificates 100
Contact Information
Back Cover
The Sultan series is a range of leading edge level instruments using Hawk’s Acoustic Wave technology. The range includes simple and also full featured level and position transmitters and switches. Functions are included for basic level or position measurement, vessel linearisation, differential or average level using two sensors, and open channel flow calculation. Flexible design allows operation from a range of power supply configurations including two wire loop power systems. Various digital communications protocols are supported as options.

**Principle of Operation**

A SULTAN 234 Series sensor transmits a high powered acoustic wave pulse, which is then reflected from the surface of the material or target to be measured.

Reflected signals are processed using highly developed algorithms to enhance the correct signal and reject false or spurious echoes.

The transmission of high powered, low frequency waves ensures minimal losses through the environment where the sensor is working. The high initial energy of the pulse, at penetrating low frequencies, ensures that any signal losses which do occur have far less negative effect than would be experienced by traditional ultrasonic devices.

The sensitive receiver circuitry of the Sultan series is designed to identify and monitor low strength return signals even when combined with high noise levels.

Measured signals are temperature compensated to provide maximum accuracy of the outputs and display.

**FEATURES**

- The SULTAN 234 Series Acoustic Wave Range offers a wide and comprehensive range of advantages
- Large selection of transducers
- Self cleaning transducers
- No contact between the transducer and the material
- Suitable for measuring rocks, powders, viscous and aggressive media
- Power supply flexibility allows for 2 wire loop power, AC and DC supplies all within a single amplifier
- Easy to calibrate and commission
- Wide spectrum of applications.
- Multiple head capability to reduce cost per unit (max 128 points)
- Open channel flow
- Differential Level
- Crane / positioning
- Average of 2 inputs
- Transducer cross talk prevention
TYPICAL APPLICATIONS

SOLID PRODUCT LEVEL
High / Low / Continuous
Granular / Powder

LIQUID PRODUCT LEVEL
High / Low / Continuous
Liquid / Chemical / Slurry

Conveyed, pneumatic air slide
Feeder pipe
Optional Remote GSM/CDMA
Remote Amplifier
Panel Mount
IP68 sensor
Flood Hood
Conveyed, pneumatic air slide
Feeder pipe
Optional Remote GSM/CDMA
Remote Amplifier
Panel Mount
IP68 sensor
Flood Hood
Reliable acoustic wave level technology for water treatment plants, for monitoring sand filter bed tanks

Application problem:
The customer had used conductivity probes to control high and low level water in their sand filter tanks. The probes were a problem because the coated up with slime and required routine cleaning.

Solution:
Hawk installed Sultan Acoustic Wave, 2 wire loop powered 20kHz transmitter. The lower frequency 20kHertz transducer provided excellent reliable control, during all sequences of the sand filter process. Maximum range of the 2 wire 20kHz transmitter is 20 m (65 ft). When the sand filter was drained the instrument had no trouble monitoring the sand and the backwash sequence, which the client could not achieve with the conductivity probes.

Using the 20 kHz frequency transmitter, provided a solution to cover all environment changes, including rain, fog, snow, condensation, some frothing during back wash etc.

Hawk manufactures the largest range of acoustic wave, 2 wire loop powered transmitters in the world, to suit all applications.

Note: Remote mounted transmitters, for the 2 wire loop powered range can be mounted up to 700 m (2300 ft) from the transducer, using belden 3084A cable.

Ordering information: (complete system)
Part no integral version: AWI2SB20T4XXXX-FA4A-4-C04
Part no remote version: AWR2SBXXXX-AWRT20T4XXXXC6-FA4A-4-C04
APPLICATION REFERENCE

Reliable level technology for coal surge bins

Application problem:
The client had been looking for a reliable level technology, to monitor level, in two 35 metre coal surge bins, that fill and empty simultaneously.

Comments:
The client tried radar, from the three major suppliers. The problem was that over a long range (35 m), the beam angle of the radar transmitters was too wide. The radar system became unreliable beyond 20 metres. The radar also suffered with build up in the focalizer cone, requiring cleaning on a periodic basis.

Solution:
The new acoustic wave level transmitter was installed and worked reliably over the full range of the 35 m silo, during filling and emptying operations. The active pulse generated by the acoustic wave transducer produced self cleaning.

Ordering information:
Part number: AWRT10T4XXXC15XX + FA10A-4 + C10-10-4 / AWR234SUXXX
APPLICATION REFERENCE

Coal Mine

Aerial conveyor tripper control
(This type of control can be applied to all types of tripper conveyor for optimizing stockpile bunker levels and also providing protection for blockages etc.)

Application Problem:
The client wanted to optimize the stockpile height and automate the movement of the tripper conveyor. The client also wanted block chute detection for the coal feeder chutes. The level transmitters also allowed the control room to see the stockpile profile for inventory control.

Solution:
The best technology solution for the level transmitters was acoustic wave. The low frequency acoustic transmitter had a maximum range of 100 metres and a very narrow beam angle. Transducers were mounted on either side of the tripper conveyor feeder chutes. High speed response of the transmitters allowed for profile control. The blocked chute control for the feeder chutes and transfer chute of the conveyor used the Gladiator microwave switches which have a pre-test function and are non intrusive.

Both the Sultan acoustic transmitters and the Gladiator microwave switches have totally fail-safe capability.

For more application details contact the factory - contact details below.

Ordering information: (complete system)
2 x AWRT10S4XXXC15 + AWR234SUXXX + Flange/Cone
3 x GSASUS + GMSB + GMRR
Reliable level technology for liquid tanks in water treatment plants

Application Problem:
Clients require reliable technology for measurement of liquid levels in a variety of tank sizes and styles. Continuous, switch point and communication options are all at times required by different control systems. Typical liquid tank applications are chemical storage tanks, day tanks and dosing and mixing tanks.

Comments:
Smaller sized (1-5m), calm liquid tanks are well suited to the compact high frequency Sultan Integral (all in one) Acoustic Wave product, using 2” BSP/NPT mounting. More general applications with condensing vapour, or foaming surfaces, agitation or over a little longer range (1-10m), will only be reliable using slightly stronger, lower frequency (20kHz) sensors, able to self clean with every high energy measuring pulse, mounted using Hawk’s recommended flange and cone.

Solution:
Hawk provides Integral (all in one) and Remote (separate transmitter and transducer) products from our Sultan Acoustic Wave range, giving reliable, continuous and switch point solutions for liquid tank level measurement, compatible with a variety of power supply and control output requirements.

Ordering information:
Integral unit- small tank:
AWI234SU30T6TB20XXX

Remote system- liquid tank:
AWR234SUXXXX
AWRT20T4XXXXC6XX
FA4A-4 + C04-4
**DIMENSIONS**

**INTEGRAL UNITS**

**Standard Flanged Type**

**Compact Type (2” BSP/NPT)**

<table>
<thead>
<tr>
<th>Dimensions Table</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sensor Frequency</td>
</tr>
<tr>
<td>-------------------</td>
</tr>
<tr>
<td>5 kHz</td>
</tr>
<tr>
<td></td>
</tr>
<tr>
<td>10 kHz</td>
</tr>
<tr>
<td></td>
</tr>
<tr>
<td>15 kHz</td>
</tr>
<tr>
<td></td>
</tr>
<tr>
<td>20 kHz</td>
</tr>
<tr>
<td>30 kHz</td>
</tr>
</tbody>
</table>

**SMART UNITS AND REMOTE TRANSDUCERS**

**Standard Flanged Type**

**Compact Type (2” BSP/NPT)**

All horns must protrude into the main volume of the vessel by at least 50 mm (2 inches) past the lower end of the mounting nozzle.
**FLANGE TYPE:**

A = ANSI Flange  
J = JIS Flange  
D = DIN Flange

**Note:** Other flange sizes available upon request.

### STANDARD ANSI/DIN/JIS FLANGE DIMENSIONS

<table>
<thead>
<tr>
<th>SIZE</th>
<th>FLANGE TYPE</th>
<th>E (PCD)</th>
<th>F (OD)</th>
<th>G (ID)</th>
<th>H (Hole)</th>
<th>No. Holes</th>
</tr>
</thead>
<tbody>
<tr>
<td>4”</td>
<td>FA4</td>
<td>190.5</td>
<td>228</td>
<td>100</td>
<td>19</td>
<td>8</td>
</tr>
<tr>
<td></td>
<td>FD4</td>
<td>180</td>
<td>220</td>
<td>100</td>
<td>19</td>
<td>8</td>
</tr>
<tr>
<td></td>
<td>FJ4</td>
<td>175</td>
<td>210</td>
<td>100</td>
<td>19</td>
<td>8</td>
</tr>
<tr>
<td>6”</td>
<td>FA6</td>
<td>241.5</td>
<td>279</td>
<td>152</td>
<td>22</td>
<td>8</td>
</tr>
<tr>
<td></td>
<td>FD6</td>
<td>235</td>
<td>285</td>
<td>152</td>
<td>22</td>
<td>8</td>
</tr>
<tr>
<td></td>
<td>FJ6</td>
<td>240</td>
<td>280</td>
<td>152</td>
<td>23</td>
<td>8</td>
</tr>
<tr>
<td>8”</td>
<td>FA8</td>
<td>298.5</td>
<td>343</td>
<td>203</td>
<td>22</td>
<td>8</td>
</tr>
<tr>
<td></td>
<td>FD8</td>
<td>295</td>
<td>340</td>
<td>203</td>
<td>22</td>
<td>8</td>
</tr>
<tr>
<td></td>
<td>FJ8</td>
<td>290</td>
<td>330</td>
<td>203</td>
<td>23</td>
<td>8</td>
</tr>
<tr>
<td>10”</td>
<td>FA10</td>
<td>362</td>
<td>406</td>
<td>255</td>
<td>26</td>
<td>12</td>
</tr>
<tr>
<td></td>
<td>FD10</td>
<td>355</td>
<td>405</td>
<td>255</td>
<td>26</td>
<td>12</td>
</tr>
<tr>
<td></td>
<td>FJ10</td>
<td>355</td>
<td>400</td>
<td>255</td>
<td>25</td>
<td>12</td>
</tr>
</tbody>
</table>

### REMOTE AMPLIFIERS

#### Field Mount

- 192.5 mm (7.6")
- 174 mm (6.9")
- 182.5 mm (7.2")

#### Panel Mount - cut out size 90x90mm (3.54x3.54")

- 96 mm (3.8")
- 89.5 mm (3.52")

Allow clearance for securing clamp screws.

Allow clearance for wiring here.
MOUNTING DIMENSIONS

2 INCH BSP/NPT THREADED NOZZLE MOUNTING

2” Pipe Dimensions

<table>
<thead>
<tr>
<th>(OD 60.3mm)</th>
<th>ID</th>
<th>Thickness</th>
</tr>
</thead>
<tbody>
<tr>
<td>Schedule 5 - 5/5S</td>
<td>57.0</td>
<td>1.65</td>
</tr>
<tr>
<td>Schedule 10 - 10/10S</td>
<td>54.8</td>
<td>2.77</td>
</tr>
<tr>
<td>Schedule 30 - 30</td>
<td>54.0</td>
<td>3.18</td>
</tr>
<tr>
<td>Schedule 40 - 40/SYD/40S</td>
<td>52.5</td>
<td>3.91</td>
</tr>
</tbody>
</table>

Ensure the face of the sensor protrudes into the vessel by more than 20mm

NOZZLE MOUNTING FOR SENSORS WITH FLANGE AND CONE

<table>
<thead>
<tr>
<th>A</th>
<th>B</th>
<th>C</th>
</tr>
</thead>
<tbody>
<tr>
<td>100mm</td>
<td>240mm 9.44in</td>
<td>100mm 4in</td>
</tr>
<tr>
<td>150mm</td>
<td>240mm 9.44in</td>
<td>150mm 6in</td>
</tr>
<tr>
<td>200mm</td>
<td>300mm 11.80in</td>
<td>200mm 8in</td>
</tr>
<tr>
<td>250mm</td>
<td>390mm 15.35in</td>
<td>300mm 12in</td>
</tr>
</tbody>
</table>

Ensure the face of the sensor protrudes into the vessel by more than 20mm
TYPICAL INSTALLATIONS

Conical Shape Vessels  |  Horizontal Cylindrical Tanks  |  Stockpiles, Stackers, Reclaimers

Always use conservative nominated distances if possible

BLANKING DISTANCE TABLE

<table>
<thead>
<tr>
<th>BLANKING DISTANCE TRANSUDCER FREQUENCY</th>
<th>Minimum</th>
<th>Nominal</th>
<th>Conservative</th>
</tr>
</thead>
<tbody>
<tr>
<td>AWRT50 50kHz</td>
<td>0.25m (10&quot;)</td>
<td>0.3m (1ft)</td>
<td>0.35m (1.2ft)</td>
</tr>
<tr>
<td>AWRT40 40kHz</td>
<td>0.3m (1.1ft)</td>
<td>0.35m (1.2ft)</td>
<td>0.4m (1.4ft)</td>
</tr>
<tr>
<td>AWRT30 30kHz</td>
<td>0.35m (1.5ft)</td>
<td>0.4m (1ft)</td>
<td>0.5m (1.6ft)</td>
</tr>
<tr>
<td>AWRT20 20kHz</td>
<td>0.5m (1.6ft)</td>
<td>0.6m (2ft)</td>
<td>0.8m (2.6ft)</td>
</tr>
<tr>
<td>AWRT15 15kHz</td>
<td>0.6m (2ft)</td>
<td>0.7m (2.2ft)</td>
<td>1.0m (3.9ft)</td>
</tr>
<tr>
<td>AWRT10 10kHz</td>
<td>1.0m (3.3ft)</td>
<td>1.1m (3.5ft)</td>
<td>1.3m (4.2ft)</td>
</tr>
<tr>
<td>AWRT5 5kHz</td>
<td>1.2m (3.9ft)</td>
<td>1.4m (4.6ft)</td>
<td>1.5m (5ft)</td>
</tr>
</tbody>
</table>
INSTALLATION GUIDE

AMPLIFIER - FIELD MOUNT
Select a suitable mounting position that is not in direct sunlight. If necessary, utilize a sunshade. Observe the minimum and maximum temperature limits (-20°C/-4°F to 60°C/140°F) Do not mount near sources of high E.M.F. such as high current cables, motor starters, or S.C.R. variable speed drives. Avoid mounting in high vibration areas such as handrails and rotating plant. Use rubber absorption mounts if mounting in light vibration areas. Remove the P.C.B. assembly before knocking out the cable and conduit entry holes.

AMPLIFIER - PANEL MOUNT
- Select a suitable position within a panel layout which allows clearance around the outside of the front panel of the unit.
- Ensure that sufficient space is available behind the panel to accommodate the depth of the amplifier housing, and also allow cable bend clearance for wiring to the terminals on the rear of the amplifier.
- Mark and cut a 90x90mm (3.54x3.54") square cut out through the panel in the desired position.
- Insert the Sultan amplifier through the panel and install supplied screw clamps into the slotted holes in the amplifier housing. Tighten the screws until just firm to secure the amplifier in place.
- Connect wiring as required to the correct terminals on the removable rear panel connectors. *When plugging connectors in to the rear panel, ensure that they are re-installed in the correct position (upper or lower).

BLANKING DISTANCE
Where possible use the conservative values and increase this distance by 50% if there is foam, dust, steam, or condensation in the vessel being monitored. *(refer to table on previous page.)* If using a flange mounting, use a rubber or neoprene gasket and washers. If using a nipple mounting, ensure that the mounting bracket is >6mm (0.24 in) from the rear of the transducer. Do not over tighten the lock nuts. When using a focaliser cone, ensure that it protrudes at least 50mm (2 in) into the vessel. If the transducer needs to be mounted above the roofline, use an appropriate standpipe or nozzle.
Use common sense when selecting the mounting position. A clear line of sight from the transducer to the product being monitored is preferred.

TRANSDUCER
Selecting a suitable position to mount the transducer on the vessel is the single **MOST IMPORTANT** step. Please read all of the installation guide and contact your Hawk representative if you have any doubts or questions. The transducer face **MUST** be at least the blanking distance away from highest product level in the bin, tank, or silo at all times. *(refer to table below.)*

MONITORING SOLIDS
In general, the transducer mounting position can be determined by measuring the distance from the infeed to the vessel wall, and mounting the transducer l/3r this distance from the wall. *(refer diagrams pages 11, 13, 15.)*
INSTALLATION GUIDE

MONITORING LIQUIDS
Mount the transducer perpendicular to the liquid surface and away from the infeed.

Avoid mounting near ladders, baffles, agitators etc. (refer to Typical Applications)

MOUNTING POSITION

NOZZLE MOUNT
Minimum 50mm (2"

FLUSH MOUNT

STAND PIPE MOUNT
Minimum 50mm (2"

TRANSDUCER MOUNTING

SOLID (Granular)
Aim transducer at point of outfeed.

LIQUID
Transducer should be as perpendicular to product as practicable.

DUAL OUTFEED
Use two transducer and select sequence option to avoid cross-talk.

POWDER
Mount away from infeed
TRANSDUCER MOUNTING

2" VERSION

Correct

Vessel roof

min 20mm inside tank

Hawk recommends a focaliser cone for all transducers as they are designed specifically to increase the acoustic performance of the Sultan product range.

Incorrect

Intrusive pipe

Hawk supplies a variety of cones for all Sultan Transducers.

Non preferred

Intrusive pipe

Hawk recommends a focaliser cone for all transducers as they are designed specifically to increase the acoustic performance of the Sultan product range.

Threaded mounting should only be used where a flange/cone mounting is impossible.

If a stand pipe MUST be used, ensure a 45° angle is cut to minimise echo return from the end of the pipe. You may need to increase the Blanking parameter to avoid seeing an incorrect return echo from the end of the pipe.
INSTALLATION GUIDE

VERTICAL LIQUID TANK APPLICATIONS

HORIZONTAL LIQUID TANK APPLICATIONS

AGITATED LIQUID TANKS

Measurement

Mount in the center part of the tank

Measurement will be from transducer or flange face to point directly below transducer in vessel.

Ensure transducer is perpendicular to liquid surface at all times.

Avoid mounting over agitator if possible

Center Transducer between Blade and Tank Sidewall

Measurement

50mm (2") Min

+/-1/4 to 1/3R

Measurement

50mm (2") Min

+/-1/4 to 1/3R

End View

Preferred

Alternate

Preferred

Alternate

Top View
OPEN CHANNEL FLOW MEASUREMENT PRINCIPLES

MOUNTING WEIR
OPEN CHANNEL FLOW MEASUREMENT PRINCIPLES

MOUNTING

PARSHALL FLUME

RECTANGULAR FLUME

Upstream Water

Overall edge

Downstream Water

4 x $h_{max}$

$\geq 5cm$

$90^\circ$
TERMINAL LAYOUTS
Sultan SMART Models

**AWSTD**

**Outputs**
- 4-20mA
- Relay
- Modbus Multidrop

**AWSTC**

**Outputs**
- Relay
- Modbus Multidrop

**AWSTA**

**Outputs**
- 4-20mA
(2) Modbus

For models with integrated junction box option, remove plug-in terminal blocks for easier wiring.

**Notes:**
(1) - No internal connection
(2) - Single Modbus connection PC to unit only
     Multidrop connection not recommended
**TERMINAL LAYOUTS**

**Sultan 234 Models**
AWI234 Series Transmitter
Integral Version (2 Relays)

![Diagram of Sultan 234 Models](image)

90-260 VAC

- Modulating 4-20mA from PLC input
- Driving 4-20mA from Sultan to user PLC

**AWR234S Series Transmitter**
Remote Field Mount (5 Relays)

![Diagram of AWR234S Series Transmitter](image)

90-260 VAC

- Modulating 4-20mA from PLC input
- Driving 4-20mA from Sultan to user PLC

**AWR234P Series Transmitter**
Remote Panel Mount (5 Relays)

![Diagram of AWR234P Series Transmitter](image)

90-260 VAC

- Modulating 4-20mA from PLC input
- Driving 4-20mA from Sultan to user PLC
Sultan 2 Models
AWI2 Series Transmitter
Integral Version

AWR2S Series Transmitter
Remote Field Mount

AWR2P Series Transmitter
Remote Panel Mount

Modulating 4-20mA from PLC input
REMOTE TRANSDUCER CONNECTION

Direct Connection to Transducer Cable

Connection via Junction Box and Extension Cable

Note: Terminal order varies with different model types, see terminal layouts page 21, 22.

*When extending transducer cable using DEKORON shielded twisted pair cable types, ensure that one pair is used to extend Blue and White, and another pair is used to extend Red and Black.
4-20mA Output Connection
Terminal Connections for AC Powered Operation
234 models with AC power option and SIM card positioned for 3/4 wire mode

a) 5 Wire – Driving from Internal Isolated Supply (Is)

NOTE:
Isolated current output can be made common with external DC Supply Positive or Negative if required. (e.g. RL – connected to GND)

b) Modulating from User’s External DC Supply (RL to Negative)

NOTE: RL Max = 750Ω if user DC Supply 24V

Sultan output is sourcing current and provides voltage to drive a passive load, PLC input or indicator.

Sultan output is sinking/controlling current. Voltage to drive current loop must be provided by PLC, indicator or external DC supply.

Sultan output is sinking/controlling current. Voltage to drive current loop must be provided by PLC, indicator or external DC supply.

Sultan output is sinking/controlling current. Voltage to drive current loop must be provided by PLC, indicator or external DC supply.

Sultan output is sourcing current and provides voltage to drive a passive load, PLC input or indicator.

Sultan output is sinking/controlling current. Voltage to drive current loop must be provided by PLC, indicator or external DC supply.

Sultan output is sinking/controlling current. Voltage to drive current loop must be provided by PLC, indicator or external DC supply.

Sultan output is sourcing current and provides voltage to drive a passive load, PLC input or indicator.

Sultan output is sinking/controlling current. Voltage to drive current loop must be provided by PLC, indicator or external DC supply.

Sultan output is sinking/controlling current. Voltage to drive current loop must be provided by PLC, indicator or external DC supply.

Sultan output is sourcing current and provides voltage to drive a passive load, PLC input or indicator.

Sultan output is sinking/controlling current. Voltage to drive current loop must be provided by PLC, indicator or external DC supply.

Sultan output is sinking/controlling current. Voltage to drive current loop must be provided by PLC, indicator or external DC supply.

Sultan output is sourcing current and provides voltage to drive a passive load, PLC input or indicator.

Sultan output is sinking/controlling current. Voltage to drive current loop must be provided by PLC, indicator or external DC supply.

Sultan output is sinking/controlling current. Voltage to drive current loop must be provided by PLC, indicator or external DC supply.

Sultan output is sourcing current and provides voltage to drive a passive load, PLC input or indicator.

Sultan output is sinking/controlling current. Voltage to drive current loop must be provided by PLC, indicator or external DC supply.

Sultan output is sinking/controlling current. Voltage to drive current loop must be provided by PLC, indicator or external DC supply.

Sultan output is sourcing current and provides voltage to drive a passive load, PLC input or indicator.

Sultan output is sinking/controlling current. Voltage to drive current loop must be provided by PLC, indicator or external DC supply.

Sultan output is sinking/controlling current. Voltage to drive current loop must be provided by PLC, indicator or external DC supply.

Sultan output is sourcing current and provides voltage to drive a passive load, PLC input or indicator.

Sultan output is sinking/controlling current. Voltage to drive current loop must be provided by PLC, indicator or external DC supply.

Sultan output is sinking/controlling current. Voltage to drive current loop must be provided by PLC, indicator or external DC supply.

Sultan output is sourcing current and provides voltage to drive a passive load, PLC input or indicator.

Sultan output is sinking/controlling current. Voltage to drive current loop must be provided by PLC, indicator or external DC supply.

Sultan output is sinking/controlling current. Voltage to drive current loop must be provided by PLC, indicator or external DC supply.

Sultan output is sourcing current and provides voltage to drive a passive load, PLC input or indicator.

Sultan output is sinking/controlling current. Voltage to drive current loop must be provided by PLC, indicator or external DC supply.

Sultan output is sinking/controlling current. Voltage to drive current loop must be provided by PLC, indicator or external DC supply.

Sultan output is sourcing current and provides voltage to drive a passive load, PLC input or indicator.

Sultan output is sinking/controlling current. Voltage to drive current loop must be provided by PLC, indicator or external DC supply.

Sultan output is sinking/controlling current. Voltage to drive current loop must be provided by PLC, indicator or external DC supply.

Sultan output is sourcing current and provides voltage to drive a passive load, PLC input or indicator.

Sultan output is sinking/controlling current. Voltage to drive current loop must be provided by PLC, indicator or external DC supply.

Sultan output is sinking/controlling current. Voltage to drive current loop must be provided by PLC, indicator or external DC supply.

Sultan output is sourcing current and provides voltage to drive a passive load, PLC input or indicator.

Sultan output is sinking/controlling current. Voltage to drive current loop must be provided by PLC, indicator or external DC supply.

Sultan output is sinking/controlling current. Voltage to drive current loop must be provided by PLC, indicator or external DC supply.

Sultan output is sourcing current and provides voltage to drive a passive load, PLC input or indicator.

Sultan output is sinking/controlling current. Voltage to drive current loop must be provided by PLC, indicator or external DC supply.

Sultan output is sinking/controlling current. Voltage to drive current loop must be provided by PLC, indicator or external DC supply.

Sultan output is sourcing current and provides voltage to drive a passive load, PLC input or indicator.

Sultan output is sinking/controlling current. Voltage to drive current loop must be provided by PLC, indicator or external DC supply.

Sultan output is sinking/controlling current. Voltage to drive current loop must be provided by PLC, indicator or external DC supply.
WIRING

4-20mA Output Connection
Terminal Connections for DC Powered Operation – AWST models and all 234 models with SIM card positioned for 3/4 wire mode.

d) 4 Wire DC – Driving from Internal Isolated Supply (Is)

![Diagram of 4 Wire DC connection]

NOTE:
Isolated current output can be made common with +DC or GND if required. (e.g. RL – connected to GND)

Use shielded cable

![Diagram of SULTAN Terminal Connection]

Sultan output is sourcing current and provides voltage to drive a passive load, PLC input or indicator.

User DC Supply

+ DC

PLC

RL Max 270Ω

4-20mA

GND

Is

SULTAN Terminal Connection

DC Supply

+ 4-20mA

Is

RL Max = 750Ω if user DC Supply 24V

Use shielded cable

4-20mA

NOTE: PLC

DCS

IND

4-20mA

Sultan output is sinking/controlling current. Voltage to drive current loop must be provided by PLC, indicator or external DC supply.

User DC Supply

+ DC

PLC

RL Max 750Ω

4-20mA

GND

Is

SULTAN Terminal Connection

DC Supply

+ 4-20mA

Is

RL Max = 750Ω if user DC Supply 24V

Use shielded cable

4-20mA

NOTE: PLC

DCS

IND

4-20mA

Sultan output is sinking/controlling current. Voltage to drive current loop must be provided by PLC, indicator or external DC supply.
Terminal Connections for DC 2 Wire 4-20mA Loop Powered Operation AWSTA, Sultan 2 and 234 models with SIM Card positioned for 2 wire mode.

**g) 2 Wire DC Loop Powered**

**4-20mA Output Connection**

Sultan provides 4-20mA current control of the same 2 wires which supply DC power to operate the unit.

**NOTE:** Internal SMART card configured for 2 wire.
## WIRING

### RELAY FUNCTIONS

#### Level Switch Contact Action

**Relay** - for Smart AWSTC/D versions  
(Set Relay Parameters in Output Adjustment menu via GosHawk2 software)

**Relay 1, 2** - for Integral 234 versions  
(Set Relay Parameters in Output Adjustment menu via local keypad or GosHawk2 software)

**Relay 1-5** - for Remote 234 versions  
(Set Relay Parameters in Output Adjustment menu via local keypad or GosHawk2 software)

**Relay Action**

<table>
<thead>
<tr>
<th>State 1</th>
<th>Energise EN</th>
<th>DeEnergise DEN</th>
<th>FailSafe FS system operating normally</th>
<th>FailSafe FS power/system/measurement failure</th>
<th>OFF</th>
</tr>
</thead>
<tbody>
<tr>
<td><img src="image1" alt="Diagram" /></td>
<td><img src="image2" alt="Diagram" /></td>
<td><img src="image3" alt="Diagram" /></td>
<td><img src="image4" alt="Diagram" /></td>
<td><img src="image5" alt="Diagram" /></td>
<td><img src="image6" alt="Diagram" /></td>
</tr>
</tbody>
</table>

**Notes:**
1. Sultan 2 and AWSTA versions do not support relay outputs.
2. Sultan 234 versions operating in 2 wire loop powered mode do not support relay outputs.
3. L1 and L2 distances are measured from the transducer face or flange face.
4. L1 must be equal to, or less than L2.

**POWER FAILURE**

<table>
<thead>
<tr>
<th>State 2</th>
<th>Energise EN</th>
<th>DeEnergise DEN</th>
<th>FailSafe FS system operating normally</th>
<th>FailSafe FS power/system/measurement failure</th>
<th>OFF</th>
</tr>
</thead>
<tbody>
<tr>
<td><img src="image7" alt="Diagram" /></td>
<td><img src="image8" alt="Diagram" /></td>
<td><img src="image9" alt="Diagram" /></td>
<td><img src="image10" alt="Diagram" /></td>
<td><img src="image11" alt="Diagram" /></td>
<td><img src="image12" alt="Diagram" /></td>
</tr>
</tbody>
</table>

**Notes:**
1. Sultan 2 and AWSTA versions do not support relay outputs.
2. Sultan 234 versions operating in 2 wire loop powered mode do not support relay outputs.
3. L1 and L2 distances are measured from the transducer face or flange face.
4. L1 must be equal to, or less than L2.
Cross Talk Prevention

The term Cross Talk is used to refer to interference between acoustic wave units of the same frequency located near to one another.

Sultan units emit high powered acoustic waves so only a small loss of signal will occur through the environment where a sensor is working. As a result, transducers located near to one another, or in a common space are likely to ‘hear’ direct or reflected signals from one another.

Cross Talk may cause one or more of a group of sensors located near to one another to generate randomly false measurements and outputs whilst giving correct performance at other times.

Cross Talk is more likely to cause problems where the applications require units to be programmed to accept fast changes of level.

It is recommended that units working near to one another be linked according to the following steps to eliminate the possibility of Cross Talk.

1. All units to be linked must be connected to a common ground, or have wiring between their ‘GND’, or their ‘DC-’ terminals (parallel connection of all units).

* GND and DC- terminals are electrically connected inside Sultan 234 units, so either one may be used.
WIRING

Cross Talk Prevention

2. At each individual unit, wire a connection between Relay 1 ‘Common’ terminal and the ‘TEST’ terminal of the same amplifier.

3. Wire a connection between the Relay 1 ‘Normally Open’ terminals of all units to be linked (parallel connection of all units).

4. In the software setup of each individual unit, program Relay 1 to ‘FS’ (Fail-safe) mode in the Output Adjust menu. (You could use a different relay number in the same way if Relay 1 is needed for another function). The units will now be linked so that they can not crosstalk.

The ‘TEST’ terminal acts as an input when the unit is about to pulse, and will cause the instrument to enter a paused state (not pulse) if it sees a connection to ground. Each unit also drives its own ‘TEST’ terminal to ground when it is busy pulsing. These two functions combined mean that if two or more units have their ‘TEST’ terminals connected in parallel, and share a common ground, then at any time when one is pulsing, it will ground the ‘TEST’ terminals of all units to which it is connected, and temporarily pause them until it is finished, then release them. The next unit which becomes ready to pulse will follow the same procedure in turn, and the process continuous in an endless cycle.

The connections described are made via a normally open relay contact, programmed into Fail-safe mode. The function of this is simply to prevent a possible lock up of the whole system if one unit has a problem e.g. power failure. If at any stage a transducer is in its failed state, it will be disconnected by the relay from the other units, so they can continue to work together.
WIRING

MULTIDROP CONNECTIONS

Multidrop GSM/GPRS/CDMA Connection*

Laptop or PC Communications using PCMCIA card or wired (PSTN) modem or Internet and remote GSM/GPRS/CDMA connection with GosHawk software.

Multidrop Connection Using HawkLink USB*

Laptop or PC Communications using HawkLink USB or RS485 / 232 converter with GosHawk software.

Multidrop Connection to PLC/DCS/SCADA*

* Wiring installation should follow RS-485 standards for layout and termination.
2 WIRE UNIT COMMUNICATIONS

The Sultan 2 wire units are 2 wire loop powered only. This means that they can not work when multi-drop connected on Modbus networks. In order to multi-drop connect units, they must not be 4-20mA (2 wire loop) powered. Gladiator, Orca, Sultan 234 or Smart AWSTC or AWSTD types are necessary for networked installations. When using an instrument powered by 2 wire connection, all current must enter and leave an instrument via the pair of loop wires, and fixed connection of other terminals in parallel to other units, or to a ground or common point may interfere with the operation of the unit, the current output, or any communications.

The communications terminals on 2 wire units are not designed for permanent connection and networked use. Communication is possible with these units, but only on a one to one basis, and only without reference to any ground. Communications on these products are provided to allow setup, commissioning and diagnosis, and during actual communication, there may be some noise generated on the current loop. It is normally best to use a laptop running on battery power only, connect only the A and B terminals, without the ground/shield, in order to minimize any noise or interference with the current loop.
WIRING

HAWKLINK GSM - CONNECTING POWER AND COMMS
USING DC POWER DERIVED FROM AC POWERED REMOTE OR INTEGRAL SULTAN 234

Using DC power from remote or integral Sultan 234 or AWSTC/AWSTD

Terminal order varies between Sultan integral, remote, and smart types. Ensure correct layout is used - see terminal layouts page xxx.
**WIRING**

**HAWKLINK GSM - CONNECTING POWER AND COMMS USING SEPARATE AC OR DC POWER WITH REMOTE OR INTEGRAL SULTAN 234 OR AWSTC/AWSTD**

<table>
<thead>
<tr>
<th>GSM</th>
<th>COMMS</th>
<th>DC-IN</th>
<th>AC-IN</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>SULTAN / AW</th>
<th>COMMS</th>
<th>DC-IN</th>
<th>AC-IN</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Separate AC power supply for the GSM module or DC power supply

Connect shield to DC "-" only at this end.

*Ensure separate DC supplies have the same ground potential*

**USING SEPARATE AC OR ISOLATED DC POWER WITH SULTAN 2, SULTAN 234 IN TWO WIRE MODE, OR AWSTA**

<table>
<thead>
<tr>
<th>GSM</th>
<th>COMMS</th>
<th>DC-IN</th>
<th>AC-IN</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>SULTAN / AW</th>
<th>COMMS</th>
<th>4-20mA</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Separate AC power supply for the GSM module or Isolated DC power supply

DC 4-20mA loop power supply

Connect shield to loop "-" only at this end.

! **TERMINAL ORDER VARIES BETWEEN SULTAN INTEGRAL, REMOTE, AN SMART TYPES. ENSURE CORRECT LAYOUT IS USED - SEE TERMINAL LAYOUTS PAGE xxx.**
WIRING

TEST TERMINAL - SULTAN 234 AND AWSTC/AWSTD ONLY

PAUSED MODE
The TEST terminal of an Sultan series product can be used as an input to the instrument, which cause it to pause in its operation. During paused mode the unit will stop making measurement pulses, and the output will hold in its current position (after any remaining damping to the current position has finished). Internal echo tracking functions such as window opening and hold time counting will continue to operate, so that when the paused state is released, the instrument will be immediately ready to resume measurement allowing for possible target movement during the paused time.

The test input can be used to silence a Sultan system when it is not required to measure, and is also used in the prevention of Cross Talk, see page XXX.

To place a Sultan unit into paused mode using the test input, a connection must be made between the power supply ground or DC- and the TEST terminal.

During paused mode, the word ‘Paused’ will be seen on the top line of the display if viewing the operating mode diagnostic.

PAUSE FROM PLC/SCADA/DCS DIGITAL OUTPUT

PLC/SCADA/DCS GROUND MUST CONNECT BACK TO SULTAN GROUND OR DC ‘-‘ TERMINALS

OPERATOR CONTROLLED PAUSE

EXTERNAL SWITCH GROUND MUST CONNECT BACK TO SULTAN GROUND OR DC ‘-‘ TERMINALS
WIRING

LIGHTNING PROTECTION

Surge Protection Device

Specifications

- Description: Surge protector for 4/20mA process instruments.
- Protection modes: Transverse & common mode
- Protection stages: Gas arrester/transorb
  Surge rating: 20kA for 8/20µs pulse
- Transverse mode clamp: Voltage 36V peak
- Arrester firing voltage: 230V peak
- Arrester residual voltage: 20V peak
- Material: Nickel plated brass, epoxy filled
- Standards compliance:
  IEEE C62.41 cat, A, B, C
  AS1768-2003 cat. A, B, C
- Approval:
  AUS Ex2428U
  Ex d IIC T4 Class 1 Zone 1
  Ex ia IIC T4 Class 1 Zone 1

Connection

3 wires: 1 to ground; 2 active (1 to each loop connection). All need to be kept as short as possible.

Remote Sultan

The enclosure can accommodate the device mounted in one of the M20 cable gland positions.

Integral Sultan

No M20 adaptor required
WIRING

CHANGE SULTAN 234 <=> SULTAN 2

It is necessary to have SULTAN 234 version to change to and from SULTAN 234 to SULTAN 2 wire connection. Wiring must be changed according to the wiring diagrams.

Note: On the module there is a removable card. The card needs to be carefully removed with the power off. The card is then turned over to show 2 wire (for 2 wire operation) or 234 wire (for 234 wire operation). Insert the card with the required wiring connection facing the sticker SMART card connection. Wire the unit as required, apply power.

INTEGRAL SULTAN 234

To change SMART CARD from 3,4 wire to 2 wire.

After screws are removed, lift facia to expose the potted modules.
CHANGE SULTAN 234 <=> SULTAN 2
Changing 2 wire to 3, 4 wire or 3,4 wire to 2 wire

For correct sim SMART CARD orientation, ensure the type of connection faces the sim card orientation sticker.

Incorrect wiring WILL CAUSE DAMAGE

Refer to manual for wiring
WIRING

CHANGE SULTAN 234 <=> SULTAN 2
Remote Sultan 234 > to change SMART CARD from 3, 4 wire to 2 wire

Sim SMART CARD Reverse/Remove

Remove screws and lift cover

For correct sim SMART CARD orientation, ensure the type of connection faces the sim card orientation sticker.

For connection to GosHawk II, see separate manual available on: www.hawkmeasure.com

Refer to manual for wiring Incorrect wiring WILL CAUSE DAMAGE
WIRING DIAGRAMS

Integral - Profibus / DeviceNet

Profibus

DeviceNet
WIRING DEVICENET

1. V-
2. CAN_L
3. SHEILD
4. CAN_H
5. V+
**DEVICENET**

Set the BaudRate and the DeviceNet Address in Sultan

Factory defaults of baudrate and FBusAdds are 125kbps and 63 in a Sultan unit with DeviceNet CommType. To modify these values follow the instructions below.

1. Go to the Output Adjustment menu
2. Use the Up and Down push buttons to reach the CommType parameter
3. Make sure that the CommTyle is set to DeviceNet
4. Press the CAL button twice
5. DeviceID will be displayed
6. Use the Down push button to reach the BaudRate parameter
7. The default value for the BaudRate is 125kbps. Press CAL button and use the Up and Down push buttons to modify this value
8. Press CAL button when finished
9. Use the Down push button to reach the FBusAdds. The default value of the FieldBus Address is 63. Press CAL button and use the Up and Down push buttons to modify this value
10. Press CAL button again when finished

Output Data

Profibus/DeviceNet now transmit 18 bytes/9 words, description of the words is as follows (For firmware version 5.54 and above)

1. Displayed Distance (Space Distance is the Primary Variable)
2. Percentage (Percent of Range)
3. Hi Level (Upper Range)
4. Low Level (Lower Range)
5. Status Flags

<table>
<thead>
<tr>
<th>Failed</th>
<th>~~~~~~</th>
<th>Search</th>
<th>0</th>
<th>Echo Cfm : 1 = True, 0 = False</th>
<th>Echo R : 1 = True, 0 = False</th>
</tr>
</thead>
<tbody>
<tr>
<td>Bit F</td>
<td>Bit E</td>
<td>Bit 3</td>
<td>Bit 1</td>
<td>Bit 0</td>
<td></td>
</tr>
</tbody>
</table>

Bit0 = Echo was received inside the span.
Bit1 = Echo is Confirmed.
Bit3 = Searching is searching for an Echo.
BitF = Unit has Failed to detect an Echo.

6. Displayed Distance2 (Second Variable)*
7. Percentage2 (Second Percent of Range)*
8. Displayed Distance3 (Third Variable)+
9. Percentage3 (Third Percent of Range)+

* Used for ORCA Sonar and Differential output on a Sultan
+Only used for ORCA Sonar Clarity output.
PROFIBUS

PROFIBUS MASTER

5. B IN
4. A IN
3. SHEILD
2. B OUT
1. A OUT

EXT TERM
PROFIBUS

Set the ProfiBus Address in Sultan

Factory defaults of FBusAdds is 126 in a Sultan unit with ProfiBus CommType. To modify this value follow the instruction below:

1. Go to the output Adjustment menu.
2. Use the Up and Down push buttons to reach the CommType parameter.
3. Make sure that the CommType is set to ProfiBus
4. Press the CAL button twice.
5. DeviceID will be displayed
6. Use the Down push button to reach the BaudRate parameter.
7. The value for the BaudRate is selected automatically and can not be modified.
8. Use the Down push button to reach the FBusAdds. The default value of the FieldBus Address is 126. Press CAL button and use the Up and Down push buttons to modify this value.
9. Press CAL button again when finish.

Output Data

ProfiBus/Devicenet now transmit 18 bytes/9 words, description of the words is as follows (For firmware version 5.54 and above)

1. Displayed Distance (Space Distance is the Primary Variable)
2. Percentage (Percent of Range)
3. Hi Level (Upper Range)
4. Low Level (Lower Range)
5. Status Flags

<table>
<thead>
<tr>
<th>Failed</th>
<th>~~~~~~</th>
<th>Search</th>
<th>0</th>
<th>Echo Cfm : 1 = True, 0 = False</th>
<th>Echo R : 1 = True, 0 = False</th>
</tr>
</thead>
<tbody>
<tr>
<td>Bit F</td>
<td>Bit E</td>
<td>Bit 3</td>
<td>Bit 1</td>
<td>Bit 0</td>
<td></td>
</tr>
</tbody>
</table>

Bit0 = Echo was received inside the span.
Bit1 = Echo is Confirmed.
Bit3 = Searching is searching for an Echo.
BitF = Unit has Failed to detect an Echo.

6. Displayed Distance2 (Second Variable)*
7. Percentage2 (Second Percent of Range)*
8. Displayed Distance3 (Third Variable)+
9. Percentage3 (Third Percent of Range)+

* Used for ORCA Sonar and Differential output on a Sultan
+Only used for ORCA Sonar Clarity output.
COMMUNICATION - MULTIDROP CONNECTION

GSM or CDMA Network

- Typically up to 31 transmitters or switches per string.
- Maximum 250 transmitters or switches.
- Using GSM/CDMA network, transmitters and switches can be monitored, calibrated remotely.
- Alarm status, diagnostics can be monitored.
- Support from factory engineering for customer application problems.

(Limited Modbus query rate for Switches only)
COMMUNICATION - REMOTE

GSM/CDMA Communication
HawkLink GSM/CDMA communication device allows any authorized computer with a standard modem and GosHawk software to dial in and calibrate, test or check on the performance of the connected Hawk product. The HawkLink device can be wired to the standard communication terminals of the Hawk products.

Remote technical support and complete commissioning of equipment in applications via our GSM/CDMA module allows monitoring and adjustments of settings no matter what corner of the world.

Protocols
- GosHawk
- HART
- Modbus
- Profibus DP
- Profibus PA
- Foundation Fieldbus
- DeviceNet
AVERAGE LEVEL

What is Average Level?

Average mode is used to measure the average of two material levels using two sensors and one amplifier, and provides one output result.

In average mode, two individual sensors are referred to as Sensor 1 and Sensor 2. Capability for averaging of more than two sensors may be added in the future.

Average Material Calculation

The display mode 'AvgMatrl' (Average Material) gives a result calculated as follows:

AvgMatrl = LowLevel – AvgSpace
where
AvgSpace = (Space1 + Space2 + offset)/2

Analog Output

Analog output is calculated based on the average material level.

The span of the analog output is defined by the LowLevel and HiLevel parameters. The analog output is calculated as follows:

Current (mA) = 16* AvgMatrl/ (LowLevel-HiLevel) + 4mA

Relays

The relays are switched based on the average space value. The relay set points L1 and L2 should be set considering the average space values at which the relay is required to switch.

*Analogue output span

* 4-20 mA action may be reversed according to setting of the ‘Analog’ parameter in the Output Adjustment menu.
To use Average mode, two sensors must be assigned different addresses.

Carefully follow the steps below starting with 2 new sensors:

1. Connect only the sensor which will be used as Sensor 2 to the amplifier.
2. In ‘Quickset’ set the ‘DispMode’ to ‘AvgMatrl’.
3. Set the ‘Sensors’ parameter to a value of 2.
4. Set the ‘1:SenAdd’ parameter to a value of 1.
5. Set the ‘1:TxAdd’ parameter to a value of 1.
7. Set the ‘2:TxAdd’ parameter to a value of 2.

The system is now ready for measurement, and in the ‘Run’ mode both sensors should pulse alternately.

Accessing both Sensors Parameters

Both sensor1 and sensor 2 parameters can be accessed through KeyPad and GosHawkII.

Via KeyPad
The parameter ‘Sensor’ in the TxSetup, Tracking and Factory menus determines which sensor (1 or 2) will be currently accessed via that menu.

Via GosHawkII
When on Run mode, press the down key once to get the ‘Tx’ value on the display. If ‘Tx’ is 1, then GosHawkII will communicate with Sensor 1 and the diagnostics displayed will refer to Sensor 1. To swap to the other sensor, hold both the ‘Up’ and ‘Down’ arrow buttons simultaneously.
AVERAGE LEVEL
DIFFERENTIAL LEVEL

What is Differential Level?

Differential Level is the term used to define the measured difference between two material levels. Measurement of Differential Level is achieved by using two sensors and one amplifier. Below is reference as to how the two sensors need to be setup and connected to the amplifier.

Sensor Addressing

Parameters 1: SenAdd and 2: SenAdd: in Quickset menu are the MODBUS addresses of sensor 1 and sensor 2 saved in the unit. The default MODBUS addresses of sensor 1 and sensor 2 are 1 and 2.

Important notes:
• Changing SenAdd, does not change the transducer modbus address.
• To change the transducer address, change the TxAdd.
• To get to TxAdd parameter press CAL twice when on SenAdd.

Both sensors which are connected to the amplifier must have different MODBUS addresses then the following needs to be carried out:

1. Set the application type to Diff on the Sultan unit;
2. Connect the sensor that is used as sensor No2.
4. Set the 2:TxAdd to 2.
DIFFERENTIAL LEVEL

Analog Output
Analog output is calculated based on the differential value. The span of the analog output is according to the Lowlevel1 and Hilevel1. The analog output is calculated according the following equation:

\[ \text{Current (mA)} = 16 \times \frac{(\text{Diff})}{(\text{LowLevel1} – \text{HiLevel1})} + 4\text{mA} \]

Relays
The relays are switched based on the diff value. This means that the relay set points L1 and L2 should be set to diff values that the relay is required to switch.

<table>
<thead>
<tr>
<th>Relay Mode = EN (L1 &lt; L2)</th>
<th>Relay Mode = DEN (L1 &lt; L2)</th>
</tr>
</thead>
<tbody>
<tr>
<td>OFF</td>
<td>ON</td>
</tr>
<tr>
<td>L2 = Diff2</td>
<td>L2 = Diff2</td>
</tr>
<tr>
<td>L1 = Diff1</td>
<td>L1 = Diff1</td>
</tr>
<tr>
<td>ON</td>
<td>OFF</td>
</tr>
</tbody>
</table>

Differential Mode
Differential Mode is introduced to measure the difference between two material levels using two sensors and one amplifier. Each sensor has its own Hi and Low levels. Parameters, LowLevel2 and HiLevel2 were introduced for sensor 2. This is useful when the sensors are not mounted at the same levels.

Diff Calculation
In differential Mode the material level measured by sensor 1 is subtracted from the material level measured by sensor 2. Negative results will be reset to zero. The differential value is calculated as follow:

\[ \text{Diff} = \text{MaterialLevel2} – \text{MaterialLevel1} \]

\[ \text{MaterialLevel2} = \text{LowLevel2} – \text{Space2} \]

\[ \text{MaterialLevel1} = \text{Lowlevel1} – \text{Space1} \]
DIFFERENTIAL LEVEL WIRING

AWR2/AWR234

Junction Box

Junction Box

AWRT-JB-01

AMP

TX1

TX2

up stream

High 2

Low 2

down stream

High 1

Low 1
OBSTRUCTIONS IN CHANNEL CAUSE RISE IN LEVEL

An obstruction in a channel represents a reduction of the cross-section of the channel. Since practical liquids are essentially incompressible, the volume of liquid flowing past an obstruction must equal the volume flowing towards it. It follows that the liquid must divert around the obstruction. If a barrier to flow is installed across the bottom of a channel, the liquid level rises as it flows over it - this leads to the use of the weir in open-channel flow measurement. If the cross-sectional area of a channel is reduced, the liquid level must rise as it flows past - this leads to the flume.

The height of the liquid surface above the Weir is called the Flow Head \((h)\). The head is known to be related to the Volume Flowrate \((q)\), allowing the flowrate to be calculated from measurement of the head.

The formula is of me form:

\[ q = kh^a \]

where the exponent \(a\) is typically about 1.5 and the constant \(k\) depends upon the channel and weir dimensions. Different shapes of weir have been developed to provide improved accuracy under different conditions, but the principle is the same for all. These various weirs have different exponents, but most within the range of 1.3 to 1.7.

Flumes, in which the channel width is narrowed have become preferred for accuracy and robustness (eg. self scrubbing). Many flume profiles have been developed, each having its advantages and disadvantages for a given application. A similar exponential relationship exists between head and flowrate in these flumes, and each type has a different exponent, commonly in the range of 1.3 to 1.8.
The Sultan series includes a product range specifically designed for machine position sensing. Such a system is typically used to provide a signal representing the linear position of a moving machine to a control system.

Sultan’s high powered Acoustic Wave measurement technology applied in this way provides a reliable, simple solution to measuring machine positions in simple or difficult environments, and is able to provide secure performance in the presence of dust, steam and with complex mechanical structures nearby.

The system is a two part (Master-Slave) system, where each part is dimensionally similar to a standard Sultan Integral or Remote level measurement system.

The master system is in fact a standard Sultan level system, with its software set for position measurement. The slave system must be ordered specifically as it uses different components to the standard Sultan system.

- Each part: Master and Slave must be selected to have the same operating frequency as one another, as they work together to generate the position measurement.

- One part is located at a fixed point, facing the moving machine, in line with its axis of movement, and slightly beyond one end of its travel. The second part is located on the moving machine, facing the fixed unit in a direct line of sight.

- All control system connections are made ONLY to the Master unit. No control connections are required, nor available at the slave end.

- The customer may choose which part (Master or Slave) is located on the moving machine, according to the location and availability of control system inputs.

- Generally it is likely that placement of the Master unit at a fixed location, and the Slave on the moving machine will provide the simplest and least costly installation, as control system cabling then only needs to connect to a fixed point, not via any moving cable system to the moving machine.

- The customer may also choose to use Integral or Remote systems for either the Master or Slave parts.

- It is likely that the most convenient installation style will include a Remote unit for the Master, and an Integral for the Slave, as there is rarely any need to access or adjust the Slave, and an Integral unit is more compact and has a lower purchase cost. At the Master end, however, a Remote unit allows a convenient local display of the measured position, and provides a neat solution for connection of control wiring, and easy adjustment of operating parameters at a user accessible location, rather than directly at the sensor position.

- The Slave unit requires only power supply connections, and the Master requires power supply and control system signal connections.

**Software Setup for Positioning Applications:**

The basic setup of a system is done almost entirely from the Master unit. There is rarely any requirement to adjust the slave at all.

Adjustment of all parameters in the Master of a positioning system is almost identical to what it would be for a level application. The Sultan operation manual description of parameter setup for level applies equally for positioning, with the following simple differences:

**Quick Set:**

- Low Level and High Level span points in the instrument represent maximum and minimum amounts of product in a level application. In
SULTAN FOR POSITION MEASUREMENT

A position application, these settings refer to maximum and minimum positions of the moving machine, so the High Level refers to the minimum separation between the sensor or flange faces of the Master and Slave units, and the Low Level represents the maximum separation between the two sensor faces.

*Units should be mounted in such a way that at least the minimum ‘Blanking Distance’ as given on the specifications of the frequency of unit being used is maintained between the Master and Slave sensor faces at all times and all possible travel distances. It is recommended that where possible, double the specified distance should be used to provide some security margin in operation.

- All distances for setup parameters, and displayed distances in the ‘Space’ mode have a zero reference at the face or flange of the Master sensor.

- Select only ‘Position’ for the ‘Application Type’ parameter of the Sultan Software to provide optimal performance when used for a positioning application.

- Normally, select ‘Space’ for the ‘Display Mode’ parameter of the Sultan Software. The display will then show the separation distance between the two sensor faces.

- Set the ‘Fill Rate’ and ‘Empty Rate’ (found under ‘Application Type’) according to the maximum possible speeds of movement of the machine: Fill Rate to the maximum speed (in metres per hour) which the machine may move toward the fixed sensor, and Empty Rate to the maximum speed (in metres per hour) which the machine may move away from the fixed sensor.

**Transducer Setup:**
- Set the ‘Gain’ as required by the application to achieve a reliable signal (0.8-2.5V).
- The setting of ‘Gain’ required for a positioning application should generally be significantly lower than that which would be needed for a level application over a similar distance. Positioning signals are direct from Master to Slave, or Slave to Master, and do not suffer the losses in reflection, or absorption in a round trip that would occur in a level application. If gain is set higher than needed, then echo signals from nearby structures can generate reflections and give false outputs.

- Check that the ‘Gain Step’ is set to a slightly lower value than the value selected above for ‘Gain’ (0.5% suggested minimum difference).

- Set the ‘Blanking Distance’ parameter to the minimum separation distance possible between the two sensors, with the moving machine at its minimum extreme of physical travel. As mentioned above, this must be greater than the ‘Blanking Distance’ given in the specifications.

- Set the ‘Empty Distance’ to slightly longer than the maximum separation distance possible between the two sensors, with the moving machine at its maximum extreme of physical travel.

*Sensors used in positioning systems can normally be used over much longer distances (typically double) than the same sensors used in a level application due to the lower losses with direct transmission and reception of signals compared to reflecting of a target.

**Advanced Note:**
- The ‘Slope Distance’ used for positioning systems is typically 2 times that used for level applications.

- Gain Values for Gain Steps and Gain parameter are generally significantly lower than the same frequency of instrument would use in a level application.
GAIN ADJUSTMENT

GAIN ADJUSTMENT (Gn)
Adjusting the Gn value will affect sensitivity of the acoustic wave system over the entire span except for that controlled by Gain Steps. The Gain Slope is not affected.

**Note:** The higher the Gain Value the more sensitive the system becomes.

SLOPE ADJUSTMENT

Adjusting the Slope value will affect how fast the Gain rises over the entire span except for that controlled by Gain Steps. The starting Gain is not affected.

**Note:** The lower the Slope Value, the steeper the Gain Curve is. The Slope value is a distance in the selected units (metres or feet).
**RECOVER ADJUSTMENT**

Gain changes automatically from Basic Gain Curve to include additional Recover Gain when necessary. Changes occur in small increments to a maximum of the Recovery value.
**SETTING THE SYSTEM**

**Things to check**
Check S value if less than approximately 1 volt increase Gn setting by 10%. The echo size should be at least 2.0 volts. Remember - anything above the Threshold value closest to the sensor will be the displayed E distance.

1. **DISPLAY DISTANCE CLOSER THAN ACTUAL LEVEL**

If the distance displayed is incorrect and a closer distance than the level echo heading go to Map and map to a distance 10% (min) past the unwanted echo.

If the incorrect displayed distance has a signal size greater than 1.0 volt it is recommended to move the sensor until the unwanted echo is less than 0.5 volts. The larger the size of the unwanted echo, the less is the likelihood of smooth transition through this point when the level reaches this distance.

The mapped echo must be smaller than the actual level. A rule of thumb is the level echo should be double the return echo signal voltage size compared to the mapped unwanted echo.

![Diagram](image)

**E1** is the incorrect distance.

Ensure the signal size S: is less than 1.0 volts - if necessary move the transducer when **E1** S value is less than 1.0V map to 2.2m.

To eliminate E1 from being considered as an echo when filling occurs at **E2** is co-incident with E1 position. **E2**
**SETTING THE SYSTEM**

![Diagram showing Echo Size Volts versus Distance (m)]

**E2** is more than double the size of **E1**, hence it is possible to monitor and follow **E2** at this **E1** mapped distance.

**Note:** It would be possible to increase the threshold value to a number greater than the **E1** signal S: value **E1** then would be smaller than the threshold hence cannot be seen by the software as a potential level echo.
SETTING THE SYSTEM

2 DISPLAY DISTANCE FURTHER THAN ACTUAL LEVEL

If the distance displayed is greater than the actual level, increase $G_n$ until the distance is displayed, on the diagnostic $E$: value then go to $S$: value and increase $G_n$ to read an approximate $S$: value of 2.0 volts.

By increasing $G_n$, it is possible to then monitor the correct level echo.

Note: It would be possible to lower the Threshold Value to ensure $E_1$ is larger than the Threshold Value.
### SPECIAL APPLICATION SETUP EXAMPLES

**Diesel Tank**

<table>
<thead>
<tr>
<th><strong>Info</strong></th>
<th><strong>Factory</strong></th>
<th><strong>Track</strong></th>
<th><strong>Tx Setup</strong></th>
<th><strong>Quick Start</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td>Serial No</td>
<td>Slope Dist(m)</td>
<td>0.300</td>
<td>Recover First(%)</td>
<td>0.0</td>
</tr>
<tr>
<td>Type</td>
<td>Slope Inc(%)</td>
<td>0.7</td>
<td>Recover Max(%)</td>
<td>0.0</td>
</tr>
<tr>
<td>SoftVer</td>
<td>Detector</td>
<td></td>
<td>Recover Inc(%)</td>
<td>0.1</td>
</tr>
<tr>
<td>ModbusID</td>
<td>GainStep1(%)</td>
<td>2.7</td>
<td>Window(m)</td>
<td>0.160</td>
</tr>
<tr>
<td>Tx Serial No</td>
<td>DistStep1(m)</td>
<td>0.350</td>
<td>Win Fwd(m)</td>
<td>0.001</td>
</tr>
<tr>
<td>Tx Model No</td>
<td>GainStep2(%)</td>
<td>15.1</td>
<td>Win Back(m)</td>
<td>0.001</td>
</tr>
<tr>
<td>Tx SoftVer</td>
<td>DistStep2(m)</td>
<td>0.500</td>
<td>Confirm</td>
<td>2</td>
</tr>
<tr>
<td>Tx ModbusID</td>
<td>GainMax(%)</td>
<td></td>
<td>Hold</td>
<td>40</td>
</tr>
<tr>
<td>PulsePwr</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>PulseRate</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Frequency</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Filter</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>I-Waste</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>AdvFilter</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>I-Charge</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Use 20 kHz

1. Do not change fields with no values shown
2. (Circled) - Values shown are suited only for the example application.
   Set according to your application specifics.

**Ash Pit**

<table>
<thead>
<tr>
<th><strong>Info</strong></th>
<th><strong>Factory</strong></th>
<th><strong>Track</strong></th>
<th><strong>Tx Setup</strong></th>
<th><strong>Quick Start</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td>Serial No</td>
<td>Slope Dist(m)</td>
<td>0.300</td>
<td>Recover First(%)</td>
<td>14.9</td>
</tr>
<tr>
<td>Type</td>
<td>Slope Inc(%)</td>
<td>0.7</td>
<td>Recover Max(%)</td>
<td>14.9</td>
</tr>
<tr>
<td>SoftVer</td>
<td>Detector</td>
<td></td>
<td>Recover Inc(%)</td>
<td>0.1</td>
</tr>
<tr>
<td>ModbusID</td>
<td>GainStep1(%)</td>
<td>2.7</td>
<td>Window(m)</td>
<td>1.000</td>
</tr>
<tr>
<td>Tx Serial No</td>
<td>DistStep1(m)</td>
<td>0.350</td>
<td>Win Fwd(m)</td>
<td>0.100</td>
</tr>
<tr>
<td>Tx Model No</td>
<td>GainStep2(%)</td>
<td>14.9</td>
<td>Win Back(m)</td>
<td>0.100</td>
</tr>
<tr>
<td>Tx SoftVer</td>
<td>DistStep2(m)</td>
<td>0.500</td>
<td>Confirm</td>
<td>2</td>
</tr>
<tr>
<td>Tx ModbusID</td>
<td>GainMax(%)</td>
<td></td>
<td>Hold</td>
<td>10</td>
</tr>
<tr>
<td>PulsePwr</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>PulseRate</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Frequency</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Filter</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>I-Waste</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>AdvFilter</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>I-Charge</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Use 20 kHz

1. Do not change fields with no values shown
2. (Circled) - Values shown are suited only for the example application.
   Set according to your application specifics.
# SPECIAL APPLICATION SETUP EXAMPLES

## Sewer Pump Station

<table>
<thead>
<tr>
<th>Info</th>
<th>Factory</th>
<th>Track</th>
<th>Tx Setup</th>
<th>Quick Start</th>
</tr>
</thead>
<tbody>
<tr>
<td>Serial No</td>
<td>15944</td>
<td>0.450</td>
<td>4.0</td>
<td>18.0</td>
</tr>
<tr>
<td>Type</td>
<td>0.7</td>
<td>0.0</td>
<td>30.0</td>
<td>12.0</td>
</tr>
<tr>
<td>ModbusID</td>
<td>0.1</td>
<td>0.5</td>
<td>0.900</td>
<td>0.000</td>
</tr>
<tr>
<td>Tx Serial No</td>
<td>0.010</td>
<td>0.200</td>
<td>0.40</td>
<td>10.0</td>
</tr>
<tr>
<td>Tx Model No</td>
<td>15.1</td>
<td>0.010</td>
<td>30.000</td>
<td>10.0</td>
</tr>
<tr>
<td>Tx ModbusID</td>
<td>0.500</td>
<td>2.0</td>
<td>10.0</td>
<td>20.00mA</td>
</tr>
</tbody>
</table>

| Type       | 01      | 0.7   | 4.0      | 18.0        |
| ModbusID   | 0.000   | 0.1   | 0.900    | 0.000       |
| Tx Serial No| 0.010  | 0.200 | 0.40     | 10.0        |
| Tx Model No | 15.1   | 0.010 | 30.000   | 10.0        |
| Tx ModbusID| 0.500   | 2.0   | 10.0     | 20.00mA     |

1. Do not change fields with no values shown
2. (Circled) - Values shown are suited only for the example application. Set according to your application specifics.

## Heavy Medium Sump

<table>
<thead>
<tr>
<th>Info</th>
<th>Factory</th>
<th>Track</th>
<th>Tx Setup</th>
<th>Quick Start</th>
</tr>
</thead>
<tbody>
<tr>
<td>Serial No</td>
<td>14284</td>
<td>0.300</td>
<td>0.0</td>
<td>20.0</td>
</tr>
<tr>
<td>Type</td>
<td>0.7</td>
<td>4.0</td>
<td>18.0</td>
<td>12.0</td>
</tr>
<tr>
<td>ModbusID</td>
<td>0.1</td>
<td>0.900</td>
<td>0.000</td>
<td>0.000</td>
</tr>
<tr>
<td>Tx Serial No</td>
<td>0.010</td>
<td>0.200</td>
<td>0.40</td>
<td>10.0</td>
</tr>
<tr>
<td>Tx Model No</td>
<td>15.1</td>
<td>0.010</td>
<td>30.000</td>
<td>10.0</td>
</tr>
<tr>
<td>Tx ModbusID</td>
<td>0.500</td>
<td>2.0</td>
<td>10.0</td>
<td>20.00mA</td>
</tr>
</tbody>
</table>

| Type       | 00      | 0.7   | 4.0      | 18.0        |
| ModbusID   | 0.1     | 0.900 | 0.000    | 0.000       |
| Tx Serial No| 0.010  | 0.200 | 0.40     | 10.0        |
| Tx Model No | 15.1   | 0.010 | 30.000   | 10.0        |
| Tx ModbusID| 0.500   | 2.0   | 10.0     | 20.00mA     |

1. Do not change fields with no values shown
2. (Circled) - Values shown are suited only for the example application. Set according to your application specifics.

*Use 20 kHz* for Sewer Pump Station

*Use 15 kHz* for Heavy Medium Sump
### SPECIAL APPLICATION SETUP EXAMPLES

#### Primary Jaw Crusher

**Info**

<table>
<thead>
<tr>
<th>Serial No</th>
<th>Slope Dist(m)</th>
<th>Recover First(%)</th>
<th>Gain(%)</th>
<th>Low Level(m)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>0.300</td>
<td>0.0</td>
<td>32.0</td>
<td>2.700</td>
</tr>
</tbody>
</table>

**Factory**

<table>
<thead>
<tr>
<th>Type</th>
<th>Slope Inc(%)</th>
<th>Recover Max(%)</th>
<th>Gain Step 3(%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>32768</td>
<td>0.7</td>
<td>0.0</td>
<td>24.0</td>
</tr>
</tbody>
</table>

**Track**

<table>
<thead>
<tr>
<th>Recover Inc(%)</th>
<th>Dist Step 3(m)</th>
<th>Threshold</th>
<th>Rate of Fill</th>
</tr>
</thead>
<tbody>
<tr>
<td>0.3</td>
<td>0.900</td>
<td>0.40</td>
<td>100.0</td>
</tr>
</tbody>
</table>

**Tx Setup**

<table>
<thead>
<tr>
<th>ModbusID</th>
<th>Win Fwd(m)</th>
<th>Window(m)</th>
<th>Dist Back(m)</th>
<th>Empty Dist(m)</th>
<th>Rate of Empty</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>1.000</td>
<td>2.000</td>
<td>1.000</td>
<td>30.000</td>
<td>100.0</td>
</tr>
</tbody>
</table>

**Quick Start**

<table>
<thead>
<tr>
<th>Tx Serial No</th>
<th>Dist Step1(m)</th>
<th>Win Fwd(m)</th>
<th>Dist Step2(m)</th>
<th>Win Back(m)</th>
<th>Temp Adj</th>
</tr>
</thead>
<tbody>
<tr>
<td>20</td>
<td>0.350</td>
<td>1.000</td>
<td>0.500</td>
<td>1.000</td>
<td>2</td>
</tr>
</tbody>
</table>

**Use 20 kHz**

1. Do not change fields with no values shown
2. Values shown are suited only for the example application.
3. Set according to your application specifics.

#### Secondary Crusher

**Info**

<table>
<thead>
<tr>
<th>Serial No</th>
<th>Slope Dist(m)</th>
<th>Recover First(%)</th>
<th>Gain(%)</th>
<th>Low Level(m)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>0.300</td>
<td>0.0</td>
<td>36.0</td>
<td>3.300</td>
</tr>
</tbody>
</table>

**Factory**

<table>
<thead>
<tr>
<th>Type</th>
<th>Slope Inc(%)</th>
<th>Recover Max(%)</th>
<th>Gain Step 3(%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>32768</td>
<td>0.7</td>
<td>0.0</td>
<td>30.0</td>
</tr>
</tbody>
</table>

**Track**

<table>
<thead>
<tr>
<th>Recover Inc(%)</th>
<th>Dist Step 3(m)</th>
<th>Threshold</th>
<th>Rate of Fill</th>
</tr>
</thead>
<tbody>
<tr>
<td>0.1</td>
<td>1.500</td>
<td>0.40</td>
<td>100.0</td>
</tr>
</tbody>
</table>

**Tx Setup**

<table>
<thead>
<tr>
<th>ModbusID</th>
<th>Win Fwd(m)</th>
<th>Window(m)</th>
<th>Dist Back(m)</th>
<th>Empty Dist(m)</th>
<th>Rate of Empty</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>1.000</td>
<td>2.000</td>
<td>1.000</td>
<td>30.000</td>
<td>100.0</td>
</tr>
</tbody>
</table>

**Quick Start**

<table>
<thead>
<tr>
<th>Tx Serial No</th>
<th>Dist Step1(m)</th>
<th>Win Fwd(m)</th>
<th>Dist Step2(m)</th>
<th>Win Back(m)</th>
<th>Temp Adj</th>
</tr>
</thead>
<tbody>
<tr>
<td>20</td>
<td>0.350</td>
<td>1.000</td>
<td>0.500</td>
<td>1.000</td>
<td>2</td>
</tr>
</tbody>
</table>

**Use 20 kHz**

1. Do not change fields with no values shown
2. Values shown are suited only for the example application.
3. Set according to your application specifics.
### SPECIAL APPLICATION SETUP EXAMPLES

#### Surge Bin

<table>
<thead>
<tr>
<th>Info</th>
<th>Factory</th>
<th>Track</th>
<th>Tx Setup</th>
<th>Quick Start</th>
</tr>
</thead>
<tbody>
<tr>
<td>Serial No</td>
<td>Slope Dist(m)</td>
<td>0.086</td>
<td>Recover First(%)</td>
<td>25.1</td>
</tr>
<tr>
<td>Type</td>
<td>Slope Inc(%)</td>
<td>0.1</td>
<td>Recover Max(%)</td>
<td>25.3</td>
</tr>
<tr>
<td>ModbusID</td>
<td>Detector</td>
<td></td>
<td>Recover Inc(%)</td>
<td>0.3</td>
</tr>
<tr>
<td>Tx Serial No</td>
<td>DistStep1(m)</td>
<td>0.550</td>
<td>Window(m)</td>
<td>3.000</td>
</tr>
<tr>
<td>Tx Model No</td>
<td>DistStep2(m)</td>
<td>0.550</td>
<td>Win Fwd(m)</td>
<td>0.200</td>
</tr>
<tr>
<td>Tx ModbusID</td>
<td>GainMax(%)</td>
<td></td>
<td>Hold</td>
<td>6</td>
</tr>
<tr>
<td>PulsePwr</td>
<td>Tx Voltage</td>
<td></td>
<td>Velocity</td>
<td></td>
</tr>
<tr>
<td>PulseRate</td>
<td>Noise Sw(%)</td>
<td></td>
<td>MapDist(m)</td>
<td></td>
</tr>
<tr>
<td>Frequency</td>
<td>Echo Width(m)</td>
<td>0.030</td>
<td>MapUsed(m)</td>
<td></td>
</tr>
<tr>
<td>Filter</td>
<td></td>
<td></td>
<td>Search First(%)</td>
<td>0.0</td>
</tr>
<tr>
<td>I-Waste</td>
<td></td>
<td></td>
<td>Movement(m)</td>
<td></td>
</tr>
<tr>
<td>AdvFilter</td>
<td>96</td>
<td></td>
<td>No of Echo</td>
<td></td>
</tr>
<tr>
<td>I-Charge</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Use 10 kHz

1. Do not change fields with no values shown
2. Circled - Values shown are suited only for the example application. Set according to your application specifics.

#### ROM Bin

<table>
<thead>
<tr>
<th>Info</th>
<th>Factory</th>
<th>Track</th>
<th>Tx Setup</th>
<th>Quick Start</th>
</tr>
</thead>
<tbody>
<tr>
<td>Serial No</td>
<td>Slope Dist(m)</td>
<td>0.800</td>
<td>Recover First(%)</td>
<td>5.1</td>
</tr>
<tr>
<td>Type</td>
<td>Slope Inc(%)</td>
<td>0.7</td>
<td>Recover Max(%)</td>
<td>5.1</td>
</tr>
<tr>
<td>SoftVer</td>
<td>Detector</td>
<td></td>
<td>Recover Inc(%)</td>
<td>0.1</td>
</tr>
<tr>
<td>ModbusID</td>
<td>GainStep1(%)</td>
<td>2.7</td>
<td>Window(m)</td>
<td>5.000</td>
</tr>
<tr>
<td>Tx Serial No</td>
<td>DistStep1(m)</td>
<td>0.550</td>
<td>Win Fwd(m)</td>
<td>1.000</td>
</tr>
<tr>
<td>Tx Model No</td>
<td>DistStep2(m)</td>
<td>1.500</td>
<td>Win Back(m)</td>
<td>0.100</td>
</tr>
<tr>
<td>Tx Serial No</td>
<td>DistStep2(m)</td>
<td>1.500</td>
<td>Confirm</td>
<td>2</td>
</tr>
<tr>
<td>Tx ModbusID</td>
<td>GainMax(%)</td>
<td></td>
<td>Hold</td>
<td>20</td>
</tr>
<tr>
<td>PulsePwr</td>
<td>Tx Voltage</td>
<td></td>
<td>Velocity</td>
<td></td>
</tr>
<tr>
<td>PulseRate</td>
<td>Noise Sw(%)</td>
<td></td>
<td>MapDist(m)</td>
<td></td>
</tr>
<tr>
<td>Frequency</td>
<td>Echo Width(m)</td>
<td>0.030</td>
<td>MapUsed(m)</td>
<td></td>
</tr>
<tr>
<td>Filter</td>
<td></td>
<td></td>
<td>Search First(%)</td>
<td>0.0</td>
</tr>
<tr>
<td>I-Waste</td>
<td></td>
<td></td>
<td>Movement(m)</td>
<td></td>
</tr>
<tr>
<td>AdvFilter</td>
<td>96</td>
<td></td>
<td>No of Echo</td>
<td></td>
</tr>
<tr>
<td>I-Charge</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Use 10 kHz

1. Do not change fields with no values shown
2. Circled - Values shown are suited only for the example application. Set according to your application specifics.
### SPECIAL APPLICATION SETUP EXAMPLES

#### Coal on Belt Detector

<table>
<thead>
<tr>
<th>Info</th>
<th>Factory</th>
<th>Track</th>
<th>Tx Setup</th>
<th>Quick Start</th>
</tr>
</thead>
<tbody>
<tr>
<td>Serial No</td>
<td>10747</td>
<td>0.400</td>
<td>22.0</td>
<td>24.0</td>
</tr>
<tr>
<td>Type</td>
<td>32768</td>
<td>0.7</td>
<td>22.0</td>
<td>24.0</td>
</tr>
<tr>
<td>SoftVer</td>
<td></td>
<td>1.3</td>
<td>22.0</td>
<td>24.0</td>
</tr>
<tr>
<td>ModbusID</td>
<td></td>
<td>1.350</td>
<td>0.1</td>
<td>2.600</td>
</tr>
<tr>
<td>Tx Serial No</td>
<td>6580</td>
<td>0.350</td>
<td>1.500</td>
<td>0.20</td>
</tr>
<tr>
<td>Tx Model No</td>
<td>05</td>
<td>1.500</td>
<td>1.500</td>
<td>0.6</td>
</tr>
<tr>
<td>Tx SoftVer</td>
<td></td>
<td>1.0</td>
<td>0.002</td>
<td>1.500</td>
</tr>
<tr>
<td>Tx ModbusID</td>
<td></td>
<td>1.0</td>
<td>0.004</td>
<td>65.500</td>
</tr>
<tr>
<td>PulsePwr:</td>
<td>Hold</td>
<td>24</td>
<td>24.0</td>
<td>20.00mA</td>
</tr>
<tr>
<td>PulseRate:</td>
<td></td>
<td></td>
<td>Hold</td>
<td>24.0</td>
</tr>
<tr>
<td>Frequency:</td>
<td></td>
<td></td>
<td>Hold</td>
<td>24.0</td>
</tr>
<tr>
<td>Filter:</td>
<td></td>
<td></td>
<td>Hold</td>
<td>24.0</td>
</tr>
<tr>
<td>I-Waste:</td>
<td></td>
<td></td>
<td>Hold</td>
<td>24.0</td>
</tr>
<tr>
<td>AdvFilter:</td>
<td>64</td>
<td></td>
<td>Hold</td>
<td>24.0</td>
</tr>
<tr>
<td>I-Charge:</td>
<td></td>
<td></td>
<td>Hold</td>
<td>24.0</td>
</tr>
</tbody>
</table>

1. Do not change fields with no values shown
2. Circled - Values shown are suited only for the example application.
   Set according to your application specifics.

#### Cement Silo

<table>
<thead>
<tr>
<th>Info</th>
<th>Factory</th>
<th>Track</th>
<th>Tx Setup</th>
<th>Quick Start</th>
</tr>
</thead>
<tbody>
<tr>
<td>Serial No</td>
<td>15325</td>
<td>0.050</td>
<td>0.0</td>
<td>30.0</td>
</tr>
<tr>
<td>Type</td>
<td></td>
<td>0.7</td>
<td>0.0</td>
<td>26.0</td>
</tr>
<tr>
<td>SoftVer</td>
<td></td>
<td>0.4</td>
<td>0.7</td>
<td>0.700</td>
</tr>
<tr>
<td>ModbusID</td>
<td></td>
<td>2.7</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Tx Serial No</td>
<td></td>
<td>0.350</td>
<td>6.000</td>
<td></td>
</tr>
<tr>
<td>Tx Model No</td>
<td>20</td>
<td>1.5</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Tx SoftVer</td>
<td></td>
<td>0.500</td>
<td>0.500</td>
<td></td>
</tr>
<tr>
<td>Tx ModbusID</td>
<td></td>
<td></td>
<td>0.500</td>
<td></td>
</tr>
<tr>
<td>PulsePwr:</td>
<td></td>
<td></td>
<td>40</td>
<td></td>
</tr>
<tr>
<td>PulseRate:</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Frequency:</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Filter:</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>I-Waste:</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>AdvFilter:</td>
<td>64</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>I-Charge:</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

1. Do not change fields with no values shown
2. Circled - Values shown are suited only for the example application.
   Set according to your application specifics.
SOFTWARE MENUS - ENTERING DATA

All software adjustments are achieved via the four PUSHBUTTONS on the front panel of the Sultan amplifier.

FROM MAIN DISPLAY

(A) Press and hold - interups normal operations and allows access to customised options. Changes headings and allows EDIT function to occur.

IN SET-UP

(B) Momentary press – saves selected value. Press and hold – scrolls through set-up menus and parameters.

(A) Increases displayed value.

(B) Scrolls up through software set-up options.

(A) Decreases displayed value.

(B) Scrolls up through software set-up options.

(A) Only used when selections are finished.

(B) Stores the current set-up in memory, and checks the validity of the software selections, then returns the Sultan to normal operating condition.

Use these 4 buttons along with the ‘software tree’ to customise the Sultan for your application.
SOFTWARE MENUS - ENTERING DATA

SOFTWARE

Space 5.72m

Unlock 0

QuickSet

Output Adj

Tx Set Up

Tracking

Code 0

Code 0

Code 195

*Press RUN button twice to revert to normal operation.
SOFTWARE MENUS - ENTERING DATA - Diagnostic Display

(1) Go to **Quickset** and enter the values for the specific application. When finished press **RUN** twice.

(2) Go to diagnostic display, the display should show. **Space 4.221m**

If you press the **pushbuttons** the following diagnostic are shown.

<table>
<thead>
<tr>
<th>Pushbuttons</th>
<th>Value</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>↑↓</td>
<td>E: 4.2</td>
<td>Instant echo distance</td>
</tr>
<tr>
<td>↑↓</td>
<td>S: 1.11V</td>
<td>Echo size in volts</td>
</tr>
<tr>
<td>↑↓</td>
<td>Gn: 37.6%</td>
<td>Gain at distance echo is detected</td>
</tr>
<tr>
<td>↑↓</td>
<td>R: 0.0%</td>
<td>The amount of gain to recover if the echo is less than threshold detection voltage level</td>
</tr>
<tr>
<td>↑↓</td>
<td>N: 1.9%</td>
<td>Noise value</td>
</tr>
<tr>
<td>↑↓</td>
<td>T: 23.2ºC</td>
<td>Temperature at sensor face</td>
</tr>
<tr>
<td>↑↓</td>
<td>W  2.0m</td>
<td>Window starting distance</td>
</tr>
<tr>
<td>↑↓</td>
<td>W  2.4m</td>
<td>Window finishing distance</td>
</tr>
<tr>
<td>↑↓</td>
<td>Normal</td>
<td>Normal or recover. Normal if echo is above threshold, Recover if below threshold</td>
</tr>
</tbody>
</table>
Volume Menu

Volume Menu is used to calculate the volume based on the material Level for different vessel shapes. The calculated (Level, Volume) table can be read from or written to a Sultan unit with amplifier software version above or equal to 3.72.

Volume Parameter Definitions

**LowLevel** = Distance from the Face of the transducer that corresponds to the low level in the vessel (4mA Analog output).

**HiLevel** = Distance from the face of the transducer that corresponds to the high level in the vessel (20mA analog output).

**h3** = Distance from the face of the transducer to the top of the vessel.

**h2** = Total height of the vessel.

**h1** = Height of the bottom section (cone or pyramid base).

**d** = Diameter of the Cylinder Section.

**d2** = Diameter of the Cone Base at the bottom.

**w** = Width of the rectangular section.

**L** = Breadth of the rectangular section.

**MaxVolume** = Maximum Calculated Volume of the Vessel.

**Density** = Density of the material inside the vessel.

**Full Scale Value (FSV)** = Maximum Capacity of the Vessel.

Volume User Guide

1. Choose the Vessel Shape.
2. Set the LowLevel and HiLevel according to your application.
3. Set the Vessel parameters such as L, w, d and h1. Refer to the vessel figure for the definition of each parameter.
4. Set the values of h2 and h3 if required (optional). Tick the Enabled box to modify h2 and h3. By default h3=HiLevel and h2=(LowLevel - HiLevel).
5. Choose the Volume unit.
6. Enter Density or Full Scale values if necessary (optional).

**Full Scale Value (FSV) = MaxVolume * Density**

In the above equation, MaxVolume is calculated by software and can not be modified. The user may enter Density or FSV to determine the other parameter.

7. Except the critical points that are shown with red colour, any pair of (Level, Volume) points can be modified. Double Click on the points to modify.
8. Click on Write Volume to write the Level/Volume table to the unit. This also saves the application setting to the database.

To write successfully, unit must be on RUN mode and amplifier software version must be 3.72 or above.

9. After writing to the unit, make sure that the display of the unit changes to Volume and the volume unit shown on the display is the same as what you selected from GosHawk.
10. Click on Read Volume to read the volume table from the unit if required.
ENTERING DATA - Volume Adjustment

Here is an example how to program Sultan with Volume:

1. Choose Vessel Shape Cylinder as show in Figure below:
2. Set LowLevel to 5.6
3. Set Hi Level to 0.5
4. Set diameter to 3.020
5. Do not select Optional Parameter. Make sure that Enable is not selected in optional parameters
6. The Max Volume that is calculated by GoshawkiI should be 36.531 as shown below.
7. Set the FSV to 200
8. Choose Cubic Meter as Volume Unit
9. Click on Write to write the Volume to the unit.
10. Now Face the transducer to a target at space = 1.709 meter

Figure 1: Volume
SOFTWARE MENUS - ENTERING DATA - Volume Adjustment

Now let's calculate the Volume

Low Level – Space = 5.6 – 1.709 = 3.891, which is between point 23 (3.740) and point 24 (3.910), Vol at point 23 is 146.7, Vol at point 24 is 153.3, therefore, our Vol shown on Tank View should between 146.7 and 153.3

- Volume shown on figure 2 is 152.6 which is between 146.7 and 153.3

- Check the Sultan unit display, Volume shown is 152.6cm

<table>
<thead>
<tr>
<th></th>
<th>Mat</th>
<th>Vol %</th>
<th>Vol</th>
</tr>
</thead>
<tbody>
<tr>
<td>Point 24</td>
<td>3.910</td>
<td>76.67</td>
<td>153.3</td>
</tr>
<tr>
<td>Point show on LED</td>
<td>3.891</td>
<td>76.29</td>
<td>152.6</td>
</tr>
<tr>
<td>Point 23</td>
<td>3.740</td>
<td>73.33</td>
<td>146.7</td>
</tr>
</tbody>
</table>

- Ok, let's calculate this Volume by ourself:

  Vol % = Mat / (LowLevel – HiLevel) * 100% = 3.891 / (5.6 – 0.5) * 100% = 76.29%
  Vol = FSV * Vol% = 200 * 76.29% = 152.58 ->> 152.6

- Therefore, the Vol shown on Tank View form is the same as Vol shown on Sultan display, and is the Volume level filled in the tank.
SOFTWARE MENUS - SETUP - Quickset

QUICKSET
To gain access to the parameter menu, press and hold the \( \text{CAL} \) button until “Unlock 0” is displayed on the LCD. Then use the \( \uparrow \downarrow \) buttons to select the access code. The factory default is 0.

Code
Allows the user to set an access code other than 0 to avoid unauthorised changes to the programming. Use the \( \uparrow \downarrow \) buttons to select the desired access code.

Units
Allows the user to select the units for display of measured distances and relay set point programming. The choices are metres/centimetres or feet/inches.

Low Level
Sets the distance from the face of the transducer that corresponds to the low level in the vessel being monitored -4mA analog output level.

High Level
Sets the distance from the face of the transducer that corresponds to the High level in the vessel being monitored - 20mA analog output level.

Note: When setting the High and Low levels a minimum span of 100mm MUST be maintained.

Fail Time
Allows the user to enter the number of pulses when a last echo condition occurs prior to failing. It is recommended to enter a minimum of 50 pulses.

Fail-safe
Allows the user to select their preferred Fail-safe condition. There are 5 possible mA output failure values. They are: 20mA, 4mA, Last Known, <4.00mA and >20.00mA.

Application Type
Allows the user to select the type of application Liquids, Slurries, Solids. The response of the system is automatically changed to allow for application requirements.

Fill Rate / Emp Rate
Allows the user to select the approximate speed of the level change. This automatically sets various parameters to allow a faster or slower response.

Display
Allows the user to select the preferred display on the LCD, options Space, Material, % Material, Flow, Avg Material, Dilhrd P, Flow Tbl, volume

Flow
Allow open channel flow using \( q=kha \).

Flow Unit
Litres, k litres, m litres, Cube ft, Cube mtrs.

Flow Exp.
This is the Expontential of the flume.

Flow Max.
This is the maximum flow for the flume.

Lo Cut Off
This is the value, typically, when the flow is less than 1cm in height it is deemed not to be flowing.
SOFTWARE MENUS - SETUP - Quickset

**QuickSet**

**CAL**

**Unit**

**CAL**

- Select unit of measurement from: Feet, Metres, Centimeters, Inches

**Low Level**

**CAL**

- Adjust vessel low level (maximum measured distance from transducer face)

**High Level**

**CAL**

- Adjust vessel high level (minimum measured distance from transducer face)

**Fail Safe**

**CAL**

- 3.50mA, 3.80mA, 20.20mA
- Last Known
- Adjust Fail time (seconds)

**App Type**

**CAL**

- Position: Slurry, Solids, Liquids
- Filled: Slurry, Solids, Liquids
- App Type: Empty Rate, Fill Rate
- Adjust vessel fill rate
- Adjust vessel empty rate

**Display Mode**

**CAL**

- Avg Matrl%, Diff O/P*, Space, Material
- Material%, Flow*, Volume, Flow Tbl
- Sensor Address: Default: 1
- Transducer IDs: Default 1

**1: SenAdd**

**CAL**

- Enter distance offset value

**Offset**

**CAL**

- Reset Amplifier to default settings
- You will be prompted to confirm action

**AmpReset**

**CAL**

- Change unlock code (default 0)

**LockCode**
SOFTWARE MENUS - SETUP - TX Setup

Gain (Gn):
This is a settable level which represents the starting value for the units receiver gain at the beginning of normal control (time varying gain control). This value will take over gain control after the last of the gain limit steps (Gs/Ds). The true effect of this parameter is to increase or decrease gain levels (and echo sizes) at all points on the gain curve, by moving the whole gain curve up or down (as if holding it by its end). This is generally used to increase or decrease the size of echoes across the whole measurement range (except for very close to the transducer, which can be controlled by fixed gain steps if required). Increasing Gain (Gn) has a similar effect to decreasing detection Threshold (Thld) and the reverse is also true.

The result of changes can be seen immediately as the unit pulses during adjustment of this parameter and displays the distance found (in SPACE mode without damping). This parameter is duplicated under the Tracking menu (only seen in code 195). Changes made either here or in Tracking will result in a change to both. It is included twice in order to simplify user access under code 0.

Gain Step (Gs):
This value represents the maximum receiver gain (%) at which the unit will operate within a distance of Ds (described below) from the transducer face. Inside this distance the receiver may operate at a lower gain if G1 and/or G2 are set to lower values than Gs, otherwise the unit will operate with a fixed gain value Gs for measurement of distances up to Ds.

Normally Gs and Ds must be considered and adjusted as a pair, and should only need adjustment to assist in masking mounting or transducer related problems.

The result of changes can be seen immediately as the unit pulses during adjustment of this parameter and displays the distance found (in SPACE mode without damping). This parameter is duplicated under the Tracking menu (only seen in code 195). Changes made either here or in Tracking will result in a change to both. It is included twice in order to simplify user access under code 0.

Distance Step (Ds):
This value represents the distance from the transducer face (in metres or feet as per the user selection) over which a gain limit of Gs will be applied. This gain limit can be used to lessen the effect of poor mountings and is the only one of the three gain steps which should be used for field problem correction (G1/D1 and G2/D2 steps are normally only used at default values to hide transmit pulse / ringing).

Normally Gs and Ds must be considered and adjusted as a pair, and should only need adjustment to assist in masking mounting or transducer related problems.
SOFTWARE MENUS - SETUP - TX Setup

The result of changes can be seen immediately as the unit pulses during adjustment of Ds either here or in Tracking will this parameter and displays the distance found (in SPACE mode without damping). This parameter is duplicated under the Tracking menu (only seen in code 195). Changes made result in a change to both. It is included twice in order to simplify user access under code 0.

Thld:
The Thld (Threshold) parameter is a settable size (in Volts), which an echo must reach in order to be detected. The instrument will accept the first echo exceeding the threshold voltage as the correct measured distance. It is the user’s responsibility to ensure that correct transducer positioning will always make the first echo detected the true level being measured (it will be if the transducer has a clear “view” of the level and no obstructions). Adjustment of the gain control parameters and threshold parameter can help to select a correct echo from a number of different echoes present. Increasing a threshold value will also increase noise immunity if the echo from the level is sufficiently strong. Do not exceed a setting of 3.00 for Threshold. The result of changes can be seen immediately as the unit pulses during adjustment of this parameter and displays the distance found (in SPACE mode without damping). This parameter is duplicated under the Tracking menu (only seen in code 195). Changes made either here or in Tracking will result in a change to both. It is included twice in order to simplify user access under code 0.

E.g: Solids and Powders = 0.5v to 1.75v
Liquids = 0.5v to 2.0v.

DistTrim: (Y/N):
Select Y to access distance calibration parameters.

Velocity:
The Velocity parameter can be used to compensate measurements being taken in gas mixtures other than air. The speed of sound is changed by different gas compositions, so an ultrasonic measurement will be inaccurate by some factor. Variation of this velocity factor until the displayed distance is corrected to a known measured distance will eliminate errors due to the speed of sound differing slightly to that found in air. Note that this kind of compensation can only be effective in a constant atmosphere.
The composition of gases being measured through must be relatively constant with time to maintain accuracy. Continuously changing gas compositions in an atmosphere will reduce accuracy of ultrasonic measurement.
Default value is 1.0000 for a compensation factor of 1.0000 (no change from air).
SOFTWARE MENUS - SETUP - TX Setup

- **Gain** 29.7%
  - **Gain Step** 21.6%
  - **Dist Step** 0.7m
  - **Threshold** 0.4V
  - **Blanking** 0.25m
  - **Empt Dist**
  - **Temp Trim**
  - **Dist Trim**
  - **Velocity**
  - **Map Dist**
  - **Map Used**

- **Adjust Gain Gn.** Press CAL to initiate single pulse. Distance to echo will be shown
- **Adjust Gain Step Gn.** Press CAL to initiate single pulse. Distance to echo will be shown
- **Adjust Distance Step.** Press CAL to initiate single pulse. Distance to echo will be shown
- **Adjust Threshold Voltage.** Press CAL to initiate single pulse. Distance to echo will be shown
- **Adjust Blanking.** Press CAL to initiate single pulse. Distance to echo will be shown
- **Adjust Empty Distance.** Press CAL to initiate single pulse. Distance to echo will be shown
- **Adjust Temp.** Press CAL to initiate single pulse. Distance to echo will be shown

*Press RUN twice to revert to normal operation*
SOFTWARE MENUS - SETUP - Output Adjustment

4mA Adj:
Whilst the display shows ‘4mA Adj’, the analog (4-20mA) current output will be forced to its 4mA state. The actual loop current can be measured with an external meter and calibrated exactly by pressing the UP or DOWN arrows until the external meter reads exactly 4.000mA. Pressing the CAL button will store the calibration in the instrument’s memory. Re-Calibration should only be necessary if a complete model reset is performed (in extended Tracking under code 195), or if parts of the electronics assembly are changed in maintenance or repair operations.

20mA Adj:
Whilst the display shows ‘20mA Adj’, the analog (4-20mA) current output will be forced to its 20mA state. The actual loop current can be measured with an external meter and calibrated exactly by pressing the UP or DOWN arrows until the external meter reads exactly 20.000mA. Pressing the CAL button will store the calibration in the instrument’s memory. Re-Calibration should only be necessary if a complete model reset is performed (in extended Tracking under code 195), or if parts of the electronics assembly are changed in maintenance or repair operations.

Analog:
4-20/20-4mA The analog current output of the instrument can be set to act in the normal (4-20mA) or reverse (20-4mA) directions. The default condition is 4-20mA, where the furthest distance from the transducer (low level) is output as 4mA, and current increases with filling to the closer (high level) span point of 20mA.

Simulate:
(Y/N): Select Y to access measurement simulation mode. In simulation mode, the UP and DOWN arrow keys vary the distance on the display. The current output and any relays used will behave exactly as they should do if the measured distance (in SPACE mode without damping) was that shown on the display. This mode can be used to test correct behavior of outputs, or externally connected equipment.

RELAYS
Allows the user to set the relays for switching. The relays are programmed in a distance from the transducer face to the position where switching is required. Relays work in the following manner:

OFF The relays will remain de-energised regardless of the measured distance or vessel contents.
The relays can be programmed to energise or de-energise depending on the product level in the vessel being monitored.

FS If FS is selected, the relay will operate as a fail safe relay. The relay will be energised at all times and will de-energise if the ultrasonic switch goes into failsafe condition.
SOFTWARE MENUS - SETUP - Output Adjustment

**Relay menu is the same for relays 1-5

*Press RUN twice to revert to normal operation
SOFTWARE MENUS - SETUP - Output Adjustment

TX Charge:
This is the voltage level for the transducer to pulse. Never enter more than 8.000V.
This should not be adjusted.

Window:
Measurements taken by the unit are expected to be able to rise or fall at a known maximum rate defined by the basic setup parameter Speed. The unit uses a window of reasonable width around its last confirmed distance measurement to aid in false echo filtering. Only echoes falling within this window are considered sensible. The window must be set wide enough to accommodate the maximum expected level change between measurement pulses, and also wide enough to be able to lose an echo, due to noise or absorption, for a short time, and still catch it again as signal conditions improve. The echo must still fall inside the window as it returns.

The Window parameter is a distance (in metres or feet as per the user selection) which represents the starting width, either side of its centre point, of the window described above (total window width will be double the value of this parameter). The base window can increase further in size, in increments of the value of the Window parameter in each direction from its centre. This will occur if no echo is found within the window after the Hold period has expired.

Window fwd:
This is the distance per pulse the window will move forward to go to another echo when the unit is in the recover mode.

Window back:
This is the distance per pulse the window will move backwards to go to another echo or when the unit is in the recover mode.

Confirm:
This is the number of times an echo must be above the entered Threshold level before it is considered validated and then after validation the output and display will move to this new position at a movement dictated by the entered damping number.

EN
The relay is normally energised and will de-energise when the product rises above the level determined by L1 and remain de-energised until the product falls below the level determined by L2.

DEN
The relay is normally de-energised and will energise when the product rises above the level determined by L1 and remain energised until the product falls below the level determined by L2.

L1
L1 determines the first switch point for relay switching.

L2
L2 determines the second switch point for relay switching.

Note:
L1 and L2 are set in the chosen display units relative to the face of the transducer.

DAMPING
Allows the user to define how quickly the switch responds to changes in the measured level within the vessel being monitored. A low damping value gives a fast response and a high damping gives a slow response. The damping limits are from 0 to 999. Eg: If you set the damping to a value of 60, the displayed distance will be the average of the last 60 pulses.
SOFTWARE MENUS - FIGURE: Comms

Profibus, DeviceNet, HART, Modbus

- **MODBUS**
  - Device ID: 1 (default)
  - Baud Rate: 19200kbps (default)

- **Profibus**
  - Device ID
  - Baud Rate
  - F BusAdd

- **DeviceNet**
  - Device ID
  - Baud Rate
  - F BusAdd

- **HART**
  - Device ID
  - Baud Rate

- **FF/PA**
  - FBusAdds (edit)
ADVANCED MENUS - Tracking

Unlock 195

QuickSet

Output Adj

Tx Setup

Tracking

RecovMax

Window

Wind Fwd

Wind Back

Confirm

Hold

Tx Charge

Sens Adds

Movement

Can only be entered by entering Unlock 195 then press CAL

*Press RUN twice to revert to normal operation
ADVANCED MENUS - Differential Level

DISPLAY MODE

DIFF O/P

LO LEVEL 2

HI LEVEL 2

SENSORS

1: SEN ADD

2: SEN ADD

OFFSET

LOCK CODE

CAL EDIT

CAL EDIT

CAL EDIT

CAL EDIT

CAL EDIT

CAL EDIT

Avg Matr 1
Diff O/P
Space
Material
Material O/P
Flow
Volume
Flow Tbl

Adjust LoLevel of Sensor 2 (metres)

Adjust HiLevel of Sensor 2 (metres)

Adjust number of sensors attached to amplifier

1-250

1-28

Adjust offset (metres)
ERROR CODES

ERROR CODE 01 - 04

Error 01: Amplifier can not talk to transducer.

Error 02: Amplifier can talk to transducer but transducer gives incorrect response.

Error 03: ProfiBus or DeviceNet is selected but ProfiBus or DeviceNet module is not connected or responding.

Error 04: Amplifier is programmed with incorrect software.

In general Error Code 01 indicates there is NO communication and Error Code 02 says there IS communication, but not of sufficient quality to be read reliably.

ERROR CODES

Error 01 Information

If Error 01 exists, then the amplifier can not communicate with the transducer, so it is impossible for it to display the address for you (the display cycle for Error 01 does not show any transducer information).

To find the transducer address you must connect directly to the transducer wires, then you will need to use the ‘ID Search- Tx ID Search’ function of GosHawkII, or the Modscan program and Txfind utility. The BLUE and WHITE transducer communication wires and a Ground connection must be connected to your PC via the RS485 converter. The PC then communicates directly with the transducer, not via the amplifier. The RED and BLACK transducer wires must remain connected to the amplifier terminals. These supply the correct power to the transducer.

The amplifier should be powered ON as normal, then press CAL until the display stops scrolling through the diagnostic messages. Start GosHawkII and use the ‘ID Search- Tx ID Search’ function. The transducer serial number will appear next to the ID number to which it is currently set. The same thing will occur if you use the Modscan program and Txfind utility.

Record the ID number found, power off, and reconnect the transducer BLUE and WHITE wires to the amplifier terminals, and connect the RS485 converter to the ‘A’ and ‘B’ Modbus terminals as normal.

Error 02 Information

Error 02 indicates a communication data corruption between AWA and Transducer. It can be a result of noise in data lines or one of data lines (“A” or “B”) being open circuit.

1. Make sure wiring is correct especially look to the screen (earth).

2. If it still doesn’t work, you should then disconnect the Transducer from AWA and check modbus ID’s of both AWA and Tx through GosHawkII “ID Search”. If the ID numbers don’t match, write down Transducer ID number and then connect AWA to GosHawkII and change it’s Modbus ID to recorded value through “Info Screen” window.

3. If the Transducer can’t communicate with GosHawkII send it back to Factory for replacement.
SAFETY INSTRUCTIONS

HAWK SULTAN SERIES

1. General

The Hawk Sultan Series Acoustic Wave equipment uses high frequency acoustic waves to measure the distance from the sensor face to the material product surface. The equipment is available as an Integral Transmitter or as a Remote system, with an Ex or non-Ex rating.

The AWI series Sultan Acoustic Wave Integral Transmitter models, as well as the AWS series Sultan Smart Transducer models consist of a transducer and an electronic control amplifier in a single housing. They are mounted directly at the level measurement point – usually at the top of a vessel and focused downwards to the product surface. The Integral Transmitter includes a user interface keypad and display, whereas the Smart Transducer is smaller in size and has no user interface except for the communication port.

The Remote Sultan system is one where an AWRT series Sultan Acoustic Wave Remote Transducer is mounted at the level measurement point, and an AWR series Sultan Remote Electronics unit is installed some distance away, in a more convenient location.

The ST Series Sonar transducers are similar to the AWRT series Sultan Acoustic Wave Remote Transducers. They are normally installed submerged in a liquid or slurry rather than in an air medium.

The TE Series and TD Series transducers are alternatives to the AWRT series Sultan Remote Transducer models. Consult the factory or local distributor for application and interface details on these.

2. Category 1 / 2 Equipment Identification

If Hawk Sultan Acoustic Wave equipment is installed and mounted in Category 1 or 2 hazardous areas, these User Manual Safety and Operating Instructions, the general Ex installation regulations and the general installation regulations for electrical equipment must all be observed. The installation of Ex instruments should only be made by trained personnel.
SAFETY INSTRUCTIONS

HAWK SULTAN SERIES

a) Intrinsic Safe (Ex ia) rated Equipment for Category 1 Gas and Dust areas (Zone 0)

Sultan AWR, AWI, AWRT, and AWST series equipment models having an Ex ia rating can be identified from information on the additional marking label according to ATEX Type Examination Certificate number ITS04ATEX22807.

Ex II 1 GD  EEx ia IIA T4  IP67 (Tamb = -20°C to 70°C)
To be compliant, the equipment must be installed with Intrinsic Barrier devices as described in Intrinsic Safe Installation. Cables from both hazardous and safe areas must be segregated from each other according to the appropriate Intrinsic Safe installation standards. Sonar transducers are rated and marked IP68 for up to 1 metre submersion depth.

b) DIP rated Equipment for Category 1 / 2 Dust areas (Zone 20 / 21)

Sultan AWR, AWI, AWRT, AWST, ST, TE and TD series equipment models having a Dust Ingress Protection rating can be identified from information on the additional marking label according to ATEX Type Examination Certificate number ITS04ATEX12896X.

Ex II 1 D T85°C  IP67
Tamb = -20°C to 75°C
To be compliant, the equipment must be installed with suitable protection for the cable. It must be protected in a suitable manner and terminated in an enclosure suitable for the environment, such as a suitably certified EEx e junction box.

c) Encapsulated (Ex m) rated Equipment for Category 2 Gas and Dust areas (Zone 1, 21)

Sultan AWRT, AWST, ST, TE and TD series equipment models with an Ex m rating can be identified from information on the additional marking label according to ATEX Type Examination Certificate number ITS04ATEX82808X.

Ex II 2 GD    EEx m II
IP68  T6 (Tamb = -20°C to 50°C)
T5 (Tamb = -20°C to 65°C)
To be compliant, the equipment must be installed with suitable protection for the cable. It must be protected in a suitable manner and terminated in an enclosure suitable for the environment, such as a suitably certified EEx e junction box.
SAFETY INSTRUCTIONS

HAWK SULTAN SERIES

d) Non Ex rated Equipment for safe areas:

Sultan equipment without Ex rating can be identified by the fact that only the standard Hawk part number / serial number marking label has been applied. This equipment must only be installed in a safe area. Cables must be protected in a suitable manner and terminated in an enclosure suitable for the environment. Refer also to temperature range in Specifications.

3. Putting Into Service

To put a Hawk Sultan Unit safely into service, the following steps must be taken:

a) Correct installation. Follow the instructions in Typical Installations and Installation Guide.

b) Remote Electronics enclosure conduit entry locations for AWR series models are shown in Dimensions – Remote Enclosure. Remove the terminal cover by loosening the two captive screws. Use a flat blade screwdriver and a slight tap to remove the selected conduit entry openings in the front of the enclosure. Follow the installation instructions in the Installation Guide and Wiring Diagram sections. Be careful to seal any unused cable glands. When wiring is complete, ensure the cable glands are securely sealed against the enclosure and the cable, then seal the terminal cover by tightening the two screws.

c) Integral Transmitter AWI series models have cable glands located at the rear of the housing which face downward to protect against moisture ingress. Ensure that cable glands are securely tightened to adequately seal the cable. Be careful to seal any unused cable glands. The Smart Transducer model AWST has one cable entry point.

d) Correct wiring. Follow the instructions in the Wiring Diagram sections. Wiring should be in accordance with relevant installation standards for hazardous area equipment or other local codes of practice.

e) Safe temperature. Temperature must not exceed the operating range of the Sultan unit. In particular, Ex rated equipment must not exceed the temperature limits stated in Category 1 / 2 Equipment Identification, above.
SAFETY INSTRUCTIONS

HAWK SULTAN SERIES

f) Safe power supply. Power supply values must be according to the Specifications.

g) It is advised to provide a cover for the unit to prevent damage that could happen due to environmental conditions.

h) Do not put into service where there is a possibility of contact with acetic acid.

4. Use

The instructions for safe use of the Sultan Unit is as follows:

a) The Sultan equipment must put into service safely. (see Putting Into Service, above).

b) This User Manual must be read and understood by any person involved with the unit.

c) Environment and installation conditions should be checked regularly.

d) When opening the cover of the any Sultan unit, prevent dust, liquids or chemical substances from getting inside the unit. Do not leave any cover open in rain or snow conditions.

e) The LCD display is visible through the clear lid of the AWR series Sultan Remote Electronics enclosure. To view the LCD display on the AWI series Sultan Integral Transmitter, open the visor by lifting up the front edge with a finger. Close and click into place again after viewing so that the display is protected from environmental effects.

f) Before making any wiring or hardware configuration changes, it is important to disconnect power from the equipment.
SAFETY INSTRUCTIONS

HAWK SULTAN SERIES

5. Assembling and dismantling

The only assembly that may be required by the user is to reconfigure a Sultan ‘234’ unit (2,3,4 wire operation) to that of a Sultan ‘2’ unit (2 wire operation). This flexibility is unique to Sultan equipment.

To safely reconfigure a Sultan ‘234’ model to that of a Sultan ‘2’ model:

a) Make sure that the original unit is a Sultan ‘234’ model (eg, AWI234 or AWR234). It is not possible to reconfigure a Sultan ‘2’ model (eg, AWI2 or AWR2) as a Sultan 234 model. Only Sultan ‘234’ models can be reconfigured to operate as Sultan ‘2’ models, and this modification is reversible.

b) Disconnect the power to the Sultan ‘234’ Unit.

c) To do the modification, follow the instructions in Wiring – Change Sultan 234 <=> Sultan 2.

d) Modify the wiring to suit the new output configuration as shown in Wiring Diagrams.

6. Installation and Wiring

Carefully follow Typical Installations, Installation Guide and Wiring Diagram sections. Follow all points listed in Putting Into Service, above. Wiring should be in accordance with relevant installation standards for hazardous area equipment or other local codes of practice.

7. Adjustment

a) Sultan Integral AWI series models:

To access the user controls, loosen the single captive screw sufficiently to release the lid. The lid can then be raised to one of two positions – 1) vertical, 2) swung right back [hinge unlocks] to gain access to the cable wiring located under the interior hinged cover flap. To close the lid, ensure that the double hinge at the top of the enclosure is locked into place before re-tightening the lid fastening screw.
SAFETY INSTRUCTIONS

HAWK SULTAN SERIES

b) Sultan Remote Electronics AWR series models:

To access the user controls, unlock the clear cover using the lever on the right hand side of the clear lid. Press this lever in the direction of the arrow (towards the lid) to release the catch. The lid can then be swung open to gain access to the user control push buttons. Close the lid when finished. To lock the lid, press on the lower part of the lever, which moves the arrow symbol (in reverse) slightly away from the lid, locking the lid closed.

c) Change of output configuration:

The only other hardware adjustment that may be desired by the user is converting from the Sultan ‘234’ output configuration to the Sultan ‘2’ output configuration. Refer to Assembling and Dismantling, above.

d) Software Adjustment:

For software adjustment of Sultan unit parameter adjustment and data entry, refer to instructions in Entering Data, and all of the Setup sections. If GosHawk II software is to be used for parameter adjustment and data entering from a lap-top computer, read and fully understand the information in the GosHawk II Manual either supplied with the equipment or downloaded free from the Hawk web-site: www.hawkmeasure.com
The AWST series models (with no buttons) can only be adjusted in this way.

8. Application Conditions

a) Voltage Supply:

Must be according to the voltage supplies given in Specifications.

b) Temperature:

Must not exceed the operating temperature range stated in Putting Into Service, above. To prevent inaccuracies due to extremes in temperature and the effect of long term UV exposure, it is recommended that transducers constructed with grey/beige polypropylene housing material be protected from direct sunlight. This does not apply to the blue/green and dark grey plastic enclosure parts. These parts have better UV stability.
HAWK SULTAN SERIES

c) Cable Connection:
Cables must only be replaced by the same cable type. If extending the cable, it must be protected in a junction box and terminated in an enclosure suitable for the environment. Refer to Wiring Diagrams – Transducer.

d) Earthing:
Hawk Sultan Acoustic Wave equipment must be earthed to ensure that shielded cabling is effective.

e) Electrostatic Discharge:
Hawk Sultan Acoustic Wave equipment has been certified safe to use in hazardous dust locations. Marking labels for Ex ia and Ex m equipment warn not to rub the surface with a dry cloth if equipment is installed in hazardous gas locations.

f) Industrial Conditions:
This equipment is designed for use in normal industrial conditions relating to humidity, vibration, etc. If the user intends to operate the equipment in more severe environmental conditions, the manufacturer or local distributor should be consulted for advice.

9. List of equipment types:

<table>
<thead>
<tr>
<th>Equipment Type</th>
<th>Approvals</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sultan Acoustic Wave Remote Electronics</td>
<td>AWR series</td>
</tr>
<tr>
<td>Sultan Acoustic Wave Remote Sonar Electronics</td>
<td>AWR Sonar Series</td>
</tr>
<tr>
<td>Sultan Acoustic Wave Remote Position Electronics</td>
<td>AWR Position Series</td>
</tr>
<tr>
<td>Sultan Acoustic Wave Remote Transducer</td>
<td>AWRT series</td>
</tr>
<tr>
<td>Sultan Acoustic Wave Remote Sonar Transducer</td>
<td>AWRT Sonar Series</td>
</tr>
<tr>
<td>Sultan Acoustic Wave Integral Transmitter</td>
<td>AWI series</td>
</tr>
<tr>
<td>Sultan Acoustic Wave Integral Sonar Transmitter</td>
<td>AWI Sonar Series</td>
</tr>
<tr>
<td>Sultan Acoustic Wave Integral Position Transmitter</td>
<td>AWI Position Series</td>
</tr>
<tr>
<td>Sultan Acoustic Wave Smart Transducer</td>
<td>AWST series</td>
</tr>
<tr>
<td>Sultan Acoustic Wave Smart Position Transducer</td>
<td>AWST Position Series</td>
</tr>
<tr>
<td>Sultan Acoustic Wave Smart Sonar Transducer</td>
<td>AWST Sonar Series</td>
</tr>
<tr>
<td>TE Series Transducer</td>
<td></td>
</tr>
<tr>
<td>TD Series Transducer</td>
<td></td>
</tr>
<tr>
<td>ST Series Transducer</td>
<td></td>
</tr>
<tr>
<td>Flange Selection</td>
<td></td>
</tr>
<tr>
<td>Cone Selection</td>
<td></td>
</tr>
<tr>
<td>Extras</td>
<td></td>
</tr>
</tbody>
</table>

Approval codes:  I = Ex ia, D = DIP,  M = Ex m
SAFETY INSTRUCTIONS

HAWK SULTAN SERIES

10. Intrinsic Safe Input / Output Parameters, IS barrier types.
Note: All equipment in Zone 0 Hazardous area must have ATEX Cat 1 marking.

A. 2-wire Integral Transmitter in Zone 0 Hazardous area.
I.S. Barrier(s) connected between Transmitter and control system.

Current Loop Input:
Ui = 28 Volts
Ii = 93 mA
Pi = 0.66 W
Ci = 0
Li = 0
Barrier Eg, MTL 7787+

Optional Communication to PLC/DCS:
Ui = 9 Volts
Ii = 120 mA
Pi = 0.54 W
Ci = 0
Li = 0
Uo = 5.9 Volts
Io = 1.13 Amps
Po = 0.66 W
Co = 1000 μF
Lo = 223 μH
L/R Ratio = 170 μH/Ω
Barrier Eg, MTL 7758+

B. 2-wire Remote Amplifier in Zone 0 Hazardous area and Transducer in Zone 0 Hazardous area.
I.S. Barrier(s) connected between Amplifier and control system.

Current Loop Input:
Ui = 28 Volts
Ii = 93 mA
Pi = 0.66 W
Li = 0
Ci = 0
Barrier Eg, MTL 7787+
Barrier Eg, MTL 7766Pac

Optional Communication to PLC/DCS:
Ui = 9 Volts
Ii = 120 mA
Pi = 0.54 W
Ci = 0
Li = 0
Uo = 5.9 Volts
Io = 1.13 Amps
Po = 0.66 W
Co = 1000 μF
Lo = 223 μH
L/R Ratio = 170 μH/Ω
Barrier Eg, MTL 7758+
SAFETY INSTRUCTIONS

HAWK SULTAN SERIES

C. 2-wire Remote Amplifier in Safe area and Transducer in Zone 0 Hazardous area.
   I.S. Barriers connected between Transducer and Amplifier.

Transducer Power: from Remote Amplifier
Uo = 12.6 Volts
Io = 2.41 Amps
Po = 1.2 W
Co = 13.5 μF
Lo = 25 μH
L/R Ratio = 37.5 μH/Ω
Barrier Eg, MTL 7766Pac

Essential Communication to Transducer:
Ui = 9 Volts
Ii = 120 mA
Pi = 0.54 W
Ci = 0
Li = 0
Uo = 5.9 Volts
Io = 1.13 Amps
Po = 0.66 W
Co = 1000 μF
Lo = 223 μH
L/R Ratio = 170 μH/Ω
Barrier Eg, MTL 7758+
HAWK SULTAN SERIES

Intrinsic Safe Input / Output Parameters, IS barrier types (cont.)

**D. 3&4-wire Integral Transmitter in Zone 0 Hazardous area. [DC pwr only, Relays = 0]**

**I.S. Barriers connected between Transmitter and control system.**

<table>
<thead>
<tr>
<th>Power Supply:</th>
<th>Optional Current Loop Supply Output: (Iₜ terminal)</th>
<th>Current Loop Output: (I⁺ terminal)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Uᵢ = 28 Volts</td>
<td>Uₒ = 25.2 Volts</td>
<td>Uᵢ = 28 Volts</td>
</tr>
<tr>
<td>Iᵢ = 93 mA</td>
<td>Iₒ = 0.482 Amps</td>
<td>Iᵢ = 93 mA</td>
</tr>
<tr>
<td>Pᵢ = 0.66 W</td>
<td>Pₒ = 0.66 W</td>
<td>Pᵢ = 0.66 W</td>
</tr>
<tr>
<td>Cᵢ = 0</td>
<td>Cₒ = 2.9 µF</td>
<td>Cᵢ = 0</td>
</tr>
<tr>
<td>Lᵢ = 0</td>
<td>Lₒ = 1.22 mH</td>
<td>Lᵢ = 0</td>
</tr>
<tr>
<td><strong>Barrier Eg. MTL 7787+</strong></td>
<td>L/R Ratio = 93 µH/Ω</td>
<td>L/R Ratio = 170 µH/Ω</td>
</tr>
</tbody>
</table>

**Barrier Eg. MTL 7787+**

**E. 3&4-wire Remote Amplifier in Zone 0 Hazardous area [DC power only, Relays = 0] and Transducer also in Zone 0 Hazardous area.**

**I.S. Barriers connected between Remote Amplifier and control system.**

<table>
<thead>
<tr>
<th>Power Supply:</th>
<th>Optional Current Loop Supply Output: (Iₜ terminal)</th>
<th>Current Loop Output: (I⁺ terminal)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Uᵢ = 28 Volts</td>
<td>Uₒ = 25.2 Volts</td>
<td>Uᵢ = 28 Volts</td>
</tr>
<tr>
<td>Iᵢ = 93 mA</td>
<td>Iₒ = 0.482 Amps</td>
<td>Iᵢ = 93 mA</td>
</tr>
<tr>
<td>Pᵢ = 0.66 W</td>
<td>Pₒ = 0.66 W</td>
<td>Pᵢ = 0.66 W</td>
</tr>
<tr>
<td>Cᵢ = 0</td>
<td>Cₒ = 2.9 µF</td>
<td>Cᵢ = 0</td>
</tr>
<tr>
<td>Lᵢ = 0</td>
<td>Lₒ = 1.22 mH</td>
<td>Lᵢ = 0</td>
</tr>
<tr>
<td><strong>Barrier Eg. MTL 7787+</strong></td>
<td>L/R Ratio = 93 µH/Ω</td>
<td>L/R Ratio = 170 µH/Ω</td>
</tr>
</tbody>
</table>

**Barrier Eg. MTL 7787+**

**F. 3&4-wire Remote Amplifier in Safe area [DC power only, Relays = 0] and Transducer in Zone 0 Hazardous area.**

**I.S. Barriers connected between Transducer and Remote Amplifier.**

**Transducer Power from Remote Amplifier**

| Uₒ = 12.6 Volts |
| Io = 2.41 Amps |
| Pₒ = 1.2 W    |
| Cₒ = 13.5 µF |
| Lₒ = 25 µH  |
| L/R Ratio = 37.5 µH/Ω |

**Barrier Eg. MTL 7766Pac**

Note: All equipment in Zone 0 Hazardous area must have ATEX Cat 1 marking
PART NUMBERING

Sultan AW REMOTE ELECTRONICS

**AWR2** Remote 2 Wire Housing/Facia Display Connection Board/Process Module, No relays
**AWR234** Remote 2/3/4 Wire Housing/Facia Display Connection Board/Process Module, 5 relays
**AWFR234** Remote 2/3/4 Wire Housing/Facia Display Connection Board/Process Module, 5 relays for Flow

**HOUSING**
- S Standard polycarbonate electronics housing
- P Panel Mount Housing

**POWER SUPPLY**
- B 24 VDC standard
- C 48 VDC for 2/3/4 units only
- U Universal AC power supply (90-260 VAC input) for 234 units only

**ADDITIONAL COMMUNICATIONS**
- S Switch only. 5 relays for AWR234 only
- X 4-20mA analogue output module, includes Modbus comms
- H HART 2 wire only
- I HART Isolated 4 wire 2/3/4 only
- W Modbus Comms only (not available for 2 wire Sultan)
- P Profibus DP*
- E Ethernet
- D DeviceNet
- Z Special Request

**INTERNAL HAWKLINK MODEM** (available with ATEX 0/20 approval)
- X Not required
- G2 GSM Frequency 800/1900 MHz/19200 Baud for USA, Canada, Chile, Argentina for Sultan 234 only
- G4 GSM Frequency 900/1800 MHz/19200 Baud for Australia, Europe, Brazil for Sultan 234 only

**APPROVAL STANDARD**
- X Not required
- A0 ATEX 0 only for AWR2 (Areas II I GD IP67 Eexia II A T4) / IECEx Ex ia IIA T4 (Tamb -20C to +70C)
- A22 ATEX Dust (Grp II Cat 3 D T85C IP67)
- GP CSA Equip Class 2, Pollution Deg.2, Measurement II (Ordinary locations)
- RN CSA Class I, Div. 1/2, Group D; Zone 0; AEx/Ex ia IIA; T4
- KN CSA Class II, Div. 2 Grp F&G; Class III

**POSITION UNIT / CRANE MASTER SOFTWARE OPTIONS**
- PS Position Slave
- CM Crane Master
- X Not required

AWR2 S B X X X X

*Cannot be used with internal HawkLink, only with remote HawkLink.*
## PART NUMBERING

### Sultan Remote Systems

#### Sultan AW Remote Transducer 3" and 3.5"

<table>
<thead>
<tr>
<th>Model</th>
<th>AWRT</th>
<th>Acoustic Wave Remote Transducer</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>Transducer Frequency</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

#### Process Temperature - Facing material selection

| S  | Standard Temperature Dry Atmosphere only, (Polyolfin face) for 4, 5, 9 and 10kHz only |
| T  | Standard Temperature (Wet Atmosphere, 3" teflon face) |
| Y  | High Temperature (Wet and Dry Atmosphere,150C, Titanium face) for 10kHz only |
| F  | 4" Full Teflon Face (for 30 and 20kHz Units only) |
| Z  | Special Request |

#### Transducer Housing Material

| 4  | Polypropylene |
| 6  | For 3" Teflon please contact factory |

#### Thread Standards for End cap

| X  | Not Required (Standard Flange Mount, see flange & cone selection) |
| TB | BSP |
| TN | NPT |

#### Mounting Thread Sizes

| X  | Not Required (Standard Flange Mount, see flange & cone selection) |
| 20 | 2" thread for 50,40,30 kHz in Tefzel housing only |
| 30 | 3" thread on the back cap for 30,20,15 kHz only. For 15kHz use "B" type flange. |
| 50 | 3.5" thread on the end cap for 10 and 5kHz only |

#### Approval Standard

| X  | Not Required |
| A0 | IECEx Zone 0 (Ex ia IIA T4) / ATEX (Grp II Cat 1 GD IP67 EX ia IIA T4) |
| A1 | ATEX Encapsulated (Grp II Cat 2 GD EEEx m II IP68) |
| A20| ATEX Dust (Grp II Cat 1 D T85C IP67) |
| A21| ATEX Dust (Grp II Cat 2 D T85C IP67) |
| A22| ATEX Dust (Grp II Cat 3 D T85C IP67) |
| GP | CSA Equip Class 2; Pollution deg 2; measurement II (ordinary locations) |
| RN | CSA Class I; Div 1/2; Group D; Zone 0; AEEx ia IIA; T4 |
| KN | CSA Class II; Div 2; Group F & G; Class III |

#### Connection

| C  | IP68 Sealed unit with cable |

#### Cable Length

| 6  | 6m cable (Standard) |
| 15 | 15m cable |
| 30 | 30m cable |
| 50 | 50m cable |
| X  | Not Required |

#### Mounting Accessories

| X  | Not Required |
| CS | Cable Suspension for remote 50/40/30/20kHz only |

#### Software Options for Sultan 234

| PS | Position Slave |
| FP | Flow - Including multiltif shading flange and fast temp compensation only available for 20, 30, 40, 50kHz |
| X  | Not required |

### AWRT 30 T 4 X X X C 6 X X
PART NUMBERING

Sultan AW SMART TRANSDUCER

**AWST**  
A  Sultan Smart, 2 wire 4-20 mA  
C  Smart Acoustic Wave Transducer with Modbus, 1 relay  
D  234 Smart Acoustic Wave Transducer with Modbus, 1 relay, 4-20 mA

**TRANSDUCER FREQUENCY**

<table>
<thead>
<tr>
<th>Frequency</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>50 50kHz</td>
<td>for applications up to 5m, available in 2” only</td>
</tr>
<tr>
<td>40 40kHz</td>
<td>for applications up to 7m, available in 2” only</td>
</tr>
<tr>
<td>30 30kHz</td>
<td>for applications up to 11m, available in 3”</td>
</tr>
<tr>
<td>20 20kHz</td>
<td>for applications up to 20m, available in 3” only *</td>
</tr>
<tr>
<td>15 15kHz</td>
<td>for applications up to 30m, available in 3” only*</td>
</tr>
<tr>
<td>10 10kHz</td>
<td>for applications up to 40m, available in 3.5” only</td>
</tr>
<tr>
<td>09 09kHz</td>
<td>for high power extended range applications up to 170m (10” cone required)</td>
</tr>
<tr>
<td>05 05kHz</td>
<td>for applications up to 60m maximum, available in 3.5” only</td>
</tr>
<tr>
<td>04 04kHz</td>
<td>for high power extended range applications up to 170m (10” cone required)</td>
</tr>
</tbody>
</table>

**PROCESS TEMPERATURE** - Facing material selection

- **S** Standard Temperature (Dry atmosphere only, Polyolfin face)  
- **T** Standard Temperature (Wet Atmosphere, teflon face)  
- **Y** High Temperature (Wet and Dry Atmosphere, 150C, Titanium face) for 10kHz only  
- **Z** Special Request

**TRANSUDER HOUSING MATERIAL**

- **4** Polypropylene  
- **6** Tefzel for 2” (standard). For 3” Teflon please contact Hawk.

**THREAD STANDARDS**

- **X** Not Required (see flange & cone selection)  
- **TB** BSP (Viton O-ring supplied)  
- **TN** NPT

**THREAD SIZES**

- **X** Not Required (standard flange mount)  
- **20** 2” thread for 50,40,30 kHz only  
- **30** 3” thread for 30,20,15 kHz only  
- **40** 2” thread with 2” cone for 20kHz only

**APPROVAL STANDARD**

- **X** Not required  
- **A1** ATEX Encapsulated (Grp II Cat 2 GD EEx m II IP68)  
- **A20** ATEX Dust (Grp II Cat 1 D T85C IP67)

**CONNECTION**

- **C** IP68 Sealed unit with 6 metre cable  
- **CS** above with suspension fitting  
- **S** Screw top unit with M20 cable gland

**Cable**

- **6** 6m cable  
- **15** 15m cable  
- **30** 30m cable  
- **50** 50m cable  
- **X** Not required (screw cap only)

**APPROVAL STANDARDS**

FM, SAA (Pending)
### PART NUMBERING

**Sultan AW INTEGRAL**

**AWI2**  Intergral 2 Wire, Housing/Facia Display Connection Board/Process Module, No relays  
**AWI234**  Intergral 2/3/4 Wire, Housing/Facia Display Connection Board/Process Module, 2 relays

#### HOUSING
- **S** Standard Plastic Moulded Housing

#### POWER SUPPLY
- **B** 24 VDC Standard
- **C** 48VDC for 234 only
- **U** Universal AC Power Supply (90-260 VAC input) and 12-30VDC, For 234 only

#### TRANSDUCER FREQUENCY
- **50** - 50kHz for applications 0-5m, available 2" only
- **40** - 40kHz for applications 0-7m, available 2" only
- **30** - 30kHz for applications up to 11m for 2" and 15m for 3" (4" cone is recommended for 3" units)
- **20** - 20kHz for applications up to 20m, available in 3" only * (4" cone is recommended)
- **15** - 15kHz for applications up to 30m, available in 3" only * (10" cone is recommended)
- **10** - 10kHz for applications up to 40m, available in 3.5" only * (10" cone is recommended)
- **09** - 9kHz for high power extended range applications up to 170m * (10" cone is recommended)
- **05** - 5kHz for applications up to 60m maximum, available in 3.5" only * (10" cone is recommended)
- **04** - 4kHz for high power extended range applications up to 170m * (10" cone is recommended)

#### PROCESS TEMPERATURE - Facing material selection
- **S** Standard Temperature Dry Atmosphere only, (polyolfin face) for 4, 5, 9 10 and 15kHz only
- **T** Standard Temperature Wet Atmosphere (teflon face)
- **Y** High Temperature (Wet & Dry Atmosphere,150C, Titanium face) 10kHz only

#### TRANSDUCER HOUSING MATERIAL
- **4** Polypropylene, Standard 30, 20, 15, 5kHz (Large Housing)
- **6** Tefzel for 2" (standard). For 3" Teflon please contact us

#### THREAD STANDARDS
- **X** Not Required (see flange & cone selection)
- **TB** BSP
- **TN** NPT

#### THREAD SIZES
- **X** Not Required
- **20** 2" thread for 50, 40, 30 kHz only
- **30** 3" thread for 30, 20, 15 kHz only
- **40** 2" thread with 2" cone for 20kHz only
- **50** 3.5" thread on the back cap for 5 and 10 kHz only

#### ADDITIONAL COMMUNICATIONS
- **S** Switch only. 5 relays for 2/3/4 only
- **X** 4-20mA analogue output module, includes Modbus comms
- **H** HART 2 wire only
- **I** HART isolated 4 wire, 2/3/4 only
- **W** Modbus comms only (not available for 2 wire)
- **P** Profibus DP
- **E** Ethernet
- **D** DeviceNet
- **Z** Special request

#### APPROVAL STANDARD
- **X** Not Required
- **A0** ATEX 0 only for AWI2
- **A22** ATEX Dust (Areas II ID T85C IP67)

#### Position/ CraneMaster Software Options
- **PS** Position Slave
- **CM** Crane Master
- **X** Not required

---

**AWI2  S  B  50  S  4  X  X  X  X  X**

---

**APPROVAL STANDARDS**

- CSA, FM, SAA (Pending)
### FLANGE SELECTION

<table>
<thead>
<tr>
<th>Flange F</th>
<th>Flange Selection</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>DIMENSION STANDARD</strong></td>
<td></td>
</tr>
<tr>
<td>A ANSI</td>
<td></td>
</tr>
<tr>
<td>D Din</td>
<td></td>
</tr>
<tr>
<td>J JIS</td>
<td></td>
</tr>
<tr>
<td>Z Special Request</td>
<td></td>
</tr>
<tr>
<td><strong>FLANGE SIZES</strong></td>
<td></td>
</tr>
<tr>
<td>2N 2&quot; NPT flange</td>
<td></td>
</tr>
<tr>
<td>2B 2&quot; BSP flange</td>
<td></td>
</tr>
<tr>
<td>3 3&quot; acoustically isolated flange</td>
<td></td>
</tr>
<tr>
<td>4 4&quot; acoustically isolated flange</td>
<td></td>
</tr>
<tr>
<td>8 8&quot; acoustically isolated flange</td>
<td></td>
</tr>
<tr>
<td>10 10&quot; acoustically isolated flange</td>
<td></td>
</tr>
<tr>
<td>Z Special Request</td>
<td></td>
</tr>
</tbody>
</table>

### CONE SELECTION

<table>
<thead>
<tr>
<th>Cone C</th>
<th>Focalizer Cone</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>CONE SIZE</strong></td>
<td></td>
</tr>
<tr>
<td>02N Adaptor for 2&quot; NPT Sensor to fit into 4&quot; cone (included)</td>
<td></td>
</tr>
<tr>
<td>02B Adaptor for 2&quot; BSP sensor to fit into 4&quot; cone (included)</td>
<td></td>
</tr>
<tr>
<td>03 3&quot; cone for 30,20 and 15kHz transducers with TB30 or TN30 threads</td>
<td></td>
</tr>
<tr>
<td>04 4&quot; cone, 30 and 20kHz 3&quot; transducer</td>
<td></td>
</tr>
<tr>
<td>08-10 8&quot; cone, 10kHz</td>
<td></td>
</tr>
<tr>
<td>10-15 10&quot; cone, 15kHz</td>
<td></td>
</tr>
<tr>
<td>10-09 10&quot; cone, 9kHz</td>
<td></td>
</tr>
<tr>
<td>10-10 10&quot; cone, 10kHz</td>
<td></td>
</tr>
<tr>
<td>10-04 10&quot; cone, 4kHz</td>
<td></td>
</tr>
<tr>
<td>10-05 10&quot; cone, 5kHz</td>
<td></td>
</tr>
</tbody>
</table>

| Cone Material | |
| 4 Polypropylene | |
| 6 Teflon | |
| 7 Carbon Fibre. Must be used with Carbon Fibre flange | |
| 7A Carbon Fibre - comes attached to Carbon Fibre ANSI flange | |
| 7B Carbon Fibre - comes attached to Carbon Fibre DIN flange | |
| 7J Carbon Fibre - comes attached to Carbon Fibre JIS flange | |
| 8 Polyurethane* | |
| Z Special Request | |

*Polyurethane can be compressed to fit into the next smaller nozzle mounting size, e.g., 8" polyurethane cone will compress into a 6" nozzle and so is 10" polyurethane in to 8" nozzle. Please confirm the maximum nozzle height allowed.*

### LOCKING RING

| Locking Ring LR | |
| Not Required | |
| 4 For 4" and 6" flanges | |
| 8 For 8" cones for 15KHz | |
| 10 For 10" flanges/cones | |

| Material 4 = Polypropylene | |

| Locking Ring | |
| LR 4 - 4 | |
### PART NUMBERING

**Full AW INTEGRAL ELECTRONICS**

<table>
<thead>
<tr>
<th>ELECTRONICS</th>
<th>FLANGE</th>
<th>CONE</th>
<th>EXTRAS</th>
</tr>
</thead>
<tbody>
<tr>
<td>AWI2SB20T4XXXXX</td>
<td>FA4A-4</td>
<td>C04-4</td>
<td>X</td>
</tr>
</tbody>
</table>

**Full AW REMOTE TRANSDUCER**

<table>
<thead>
<tr>
<th>ELECTRONICS</th>
<th>FLANGE</th>
<th>CONE</th>
<th>EXTRAS</th>
</tr>
</thead>
<tbody>
<tr>
<td>AWRT50S4XXXXC6XX</td>
<td>FA4A-4</td>
<td>C04-4</td>
<td>X</td>
</tr>
</tbody>
</table>

**Full AW SERIES SMART TRANSDUCER UNIT**

<table>
<thead>
<tr>
<th>ELECTRONICS</th>
<th>FLANGE</th>
<th>CONE</th>
<th>EXTRAS</th>
</tr>
</thead>
<tbody>
<tr>
<td>AWSTA30S4XXXXC6</td>
<td>FA4A-4</td>
<td>C04-4</td>
<td>X</td>
</tr>
</tbody>
</table>

**Full AW REMOTE ELECTRONICS**

<table>
<thead>
<tr>
<th>ELECTRONICS</th>
<th>EXTRAS</th>
</tr>
</thead>
<tbody>
<tr>
<td>AWR234SUXXXXX</td>
<td>X</td>
</tr>
</tbody>
</table>

To be used with AW Series Remote Transducer

---

Additional product warranty and application guarantees upon request.

Technical data subject to change without notice.

All company or product names are registered trademarks or trademarks of their respective owners.

For the latest updates go to www.hawkmeasure.com
SPECIFICATIONS

Frequency
• 4kHz, 5kHz, 9kHz, 10kHz, 15kHz, 20kHz, 30kHz, 40kHz, 50kHz

Operating Voltage
• 12 - 30Vdc (residual ripple no greater than 100mV)
• 90 - 265Vac 50/60Hz
• 48Vdc, 48Vac-90Vac 50/60Hz

Power Consumption
• <3W @ 24Vdc
• <10VA @ 240Vac
• <4W @ 48Vdc, <7VA @ 48Vac – 90Vac.

Analog Output
• 4 -20mA (750 ohms @ 24Vdc User supply, 250 ohms internally driven)

Communications
• GosHawk, HART, Modbus, Profibus DP, DeviceNet, Foundation Fieldbus, Profibus PA. Multidrop mode can address 1-250 units over 4 wire

Relay Output
(2) Integral (5) Remote
• Form ‘C’ (SPDT) contacts, rated 0.5A at 240Vac non-inductive.
• All relays have independently adjustable dead bands.
• Remote fail-safe test facility for one relay.

Blanking Distance
• 50kHz = 0.25 m (10")
• 40kHz = 0.30 m (12")
• 30kHz = 0.35 m (14")
• 20kHz = 0.50 m (20")
• 15kHz = 0.60 m (24")
• 10/9kHz = 1.0 m (39")
• 5/4kHz = 1.5 m (59")

Maximum Range
• 5m (16ft) 50kHz liquids
• 7m (22ft) 40kHz liquids
• 10m (33ft) 30kHz liquids, 5m (16ft) solids
• 20m (65ft) 20kHz liquids/slurries, 10m (33ft) solids
• 30m (98ft) 15kHz liquids/slurries, 20m (65ft) solids
• 50m (165ft) 10kHz liquids/slurries/powders/solids
• 60m (196ft) 5kHz liquids/slurries/powders/solids
• 180m (588ft) 4/9 kHz for extended range

Resolution
• 1 mm (0.04") 50, 40, 30,20, 15, 10, 5kHz
• 4 mm (0.2") 9, 4kHz

Sensor Accuracy
• +/- 0.25% of measured range

Operating Temperature
• Integral System -40°C (-40°F) to 80°C (176°F)
• Remote electronics -40°C (-40°F) to 80°C (176°F)
• Remote transducer -40°C (-40°F) to 80°C (176°F)
• -40°C (-40°F) to 175°C (Hi-Temp. version)

Transducer/Amplifier Separation
• Up to 1000m using specified extension cable

Cable
• 4 conductor shielded twisted pair instrument cable.
• Conductor size dependent on cable length.
• BELDEN 3084A, DEKORON or equivalent.
• Max: BELDEN 3084A = 500m (1640 ft)
• Max: DEKORON IED183AA002 = 350m (980 ft)

Maximum Operating Pressure
• +/- 7.5 PSI (+/- 0.5 Bar)

Beam Angle
• 7.5° without focaliser 50kHz/40kHz/30kHz
• 4° with focaliser 50kHz/40kHz
• 6° with focaliser 30kHz/20kHz/15kHz/10kHz/5kHz
• 10° with focaliser 9kHz/4kHz

Display
• 2 line x 8 digit alphanumeric LCD

Memory
• Non-Volatile (No backup battery required)
SPECIFICATIONS

• >10 years data retention

**Enclosure Sealing**
- Integral System IP67
- Remote Electronics IP65 (Nema 4x)
- Remote Transducer IP68

**Cable Entries**
- Integral: 3 x M16 Glands
- Remote: 3 x 20mm, 1 x 16mm knock outs.

**Mounting**
- ANSI, JIS or DIN Flange
- 4 in/100mm to 10 in/250mm
- 2in BSP Thread / NPT Thread

**Typical Weight**
Sultan AW System with appropriate flange and cone
- 4 or 5kHz Transducer 13kg, 28.6lb
- 9 or 10kHz Transducer 10kg, 22lb
- 15kHz Transducer 8kg, 17.6lb
- 20 or 30kHz (3”) Transducer 3kg, 6.6lb
- 30 (2”), 40 or 50kHz Transducer 1kg, 2.2lb

**Configuration**

<table>
<thead>
<tr>
<th>Configuration</th>
<th>kg</th>
<th>lb</th>
</tr>
</thead>
<tbody>
<tr>
<td>Remote system with 6m cable</td>
<td>1</td>
<td>2.2</td>
</tr>
<tr>
<td>R15 Remote system with 15m cable</td>
<td>3</td>
<td>6.6</td>
</tr>
<tr>
<td>R30 Remote system with 30m cable</td>
<td>6</td>
<td>13.2</td>
</tr>
<tr>
<td>R50 Remote system with 50m cable</td>
<td>10</td>
<td>22.0</td>
</tr>
</tbody>
</table>
## SOUND VELOCITIES

### Sound Velocities for Gases at 0°C

<table>
<thead>
<tr>
<th>Substance</th>
<th>Metres per Second</th>
<th>Feet per Second</th>
</tr>
</thead>
<tbody>
<tr>
<td>Dry air</td>
<td>331</td>
<td>1086</td>
</tr>
<tr>
<td>Ammonia</td>
<td>415</td>
<td>1362</td>
</tr>
<tr>
<td>Argon</td>
<td>308</td>
<td>1010</td>
</tr>
<tr>
<td>Carbon Dioxide</td>
<td>259</td>
<td>850</td>
</tr>
<tr>
<td>Carbon Monoxide</td>
<td>338</td>
<td>1109</td>
</tr>
<tr>
<td>Chlorine</td>
<td>206</td>
<td>676</td>
</tr>
<tr>
<td>Dueterium</td>
<td>890</td>
<td>2920</td>
</tr>
<tr>
<td>Ethane (10°C)</td>
<td>308</td>
<td>1010</td>
</tr>
<tr>
<td>Ethylene</td>
<td>317</td>
<td>1040</td>
</tr>
<tr>
<td>Helium</td>
<td>965</td>
<td>3166</td>
</tr>
<tr>
<td>Hydrogen</td>
<td>1284</td>
<td>4213</td>
</tr>
<tr>
<td>Hydrogen Bromide</td>
<td>200</td>
<td>656</td>
</tr>
<tr>
<td>Hydrogen Chloride</td>
<td>206</td>
<td>676</td>
</tr>
<tr>
<td>Hydrogen Iodide</td>
<td>157</td>
<td>515</td>
</tr>
<tr>
<td>Hydrogen Sulfide</td>
<td>289</td>
<td>948</td>
</tr>
<tr>
<td>Illuminating (Coal Gas)</td>
<td>453</td>
<td>1486</td>
</tr>
<tr>
<td>Methane</td>
<td>430</td>
<td>1411</td>
</tr>
<tr>
<td>Neon</td>
<td>435</td>
<td>1427</td>
</tr>
<tr>
<td>Nitric Oxide (10°C)</td>
<td>324</td>
<td>1063</td>
</tr>
<tr>
<td>Nitrogen</td>
<td>334</td>
<td>1096</td>
</tr>
<tr>
<td>Nitrous Oxide</td>
<td>263</td>
<td>863</td>
</tr>
<tr>
<td>Oxygen</td>
<td>316</td>
<td>1037</td>
</tr>
<tr>
<td>Sulphur Dioxide</td>
<td>213</td>
<td>699</td>
</tr>
</tbody>
</table>

### Sound Velocities for Vapours at 0°C

<table>
<thead>
<tr>
<th>Substance</th>
<th>Metres per Second</th>
<th>Feet per Second</th>
</tr>
</thead>
<tbody>
<tr>
<td>Acetone</td>
<td>230</td>
<td>755</td>
</tr>
<tr>
<td>Benzene</td>
<td>202</td>
<td>663</td>
</tr>
<tr>
<td>Carbon Tetrachloride</td>
<td>145</td>
<td>476</td>
</tr>
<tr>
<td>Chloroform</td>
<td>171</td>
<td>561</td>
</tr>
<tr>
<td>Ethanol</td>
<td>269</td>
<td>883</td>
</tr>
<tr>
<td>Ethyl Ether</td>
<td>206</td>
<td>676</td>
</tr>
</tbody>
</table>

**NOTE:**

Speed of sound can vary with the medium through which the sound pulse travels. The Sultan is set for Dry Air at 331m/second. To change the Velocity see page 59.
DECLARATION OF CONFORMITY

Manufacturer's Name: HAWK MEASUREMENT SYSTEMS PTY LTD
Manufacturer's Address: 15–17 Maurice Court
                        Nunawading, Vic.
                        Australia 3131

declares that the product SULTAN Series Acoustic Wave Level Transmitter

Models
    AWI2, AW1234, AWR2, AWR234, AWRT, AWIH2, AWIH234, AWRH2,
    AWRH234, AWRTH, AWSTHA, AWSTHB, AWSTHC and AWSTHD.

conform to the following product specifications:

Amendment Directive:      93/68/EEC
EMC Directive:            89/336/EEC

Standards in whole or in part to which conformity is declared:
                          EN 61010-1:2001
                          EN 50014:1997 + Amendments 1 & 2:1999
                          EN 50020:2002
                          EN 50028:1987
                          EN 50281-1-1:1998
                          EN 50284:1999

Standards:
    IEC 1000-3-2: 1995  IEC 1000-4-4: 1995
    IEC 1000-3-3: 1994  IEC 1000-4-5: 1995
    IEC 1000-4-2: 1995  IEC 1000-4-6: 1996
    IEC 1000-4-3: 1995  IEC 1000-4-11: 1994

Supplemental Information:
Under ATEX Directive 94/9/EC, the above models have been certified by Intertek. These products comply

Signature: Colin Prohasky
Name: Colin Prohasky
Position: Engineering Manager
Date: 9 August 2006
Place: Melbourne, Australia.
Certificate of Compliance

EMC Technologies Report No: M030826
Issue Date: 6th January 2005

Test Sample: Sultan Series Acoustic Wave Level Transmitters
Model: AWR234SUMX (Remote) and AWI234SU30STB20MX (Integral)

Manufacturer: Hawk Measurement Systems Pty Ltd
Address: 15-17 Maurice Court (PO box 286)
          Nunawading, Vic 3131
Phone: (03) 9873 4750
Fax: (03) 9873 4538
Contact: Colin Prohasky (Engineering Manager)
Web site: www.hawklevel.com

Tested for: Hawk Measurement Systems Pty Ltd
Address: 15-17 Maurice Court,
          Nunawading VIC 3131 Australia
Phone: +613 9873 4750
Fax: +613 9873 4538
Contact: Colin Prohasky
Email: colin@hawk.com.au

  Electrical equipment for measurement, control and laboratory use –
  EMC requirements

Result of Test: The Test Sample complied with the above Standard. Refer to
  Report M030826 for full details


Test Officers: Janath Gunasekera  Steven Kolar

Authorised Signature: Petra Hansen
EMC Technologies Pty Ltd

*EN61000-3-2 Current Harmonics and EN61000-3-3 Voltage Flicker tests referenced in EN61326-1 are not within
the current scope of NATA accreditation.

Issued by EMC Technologies Pty. Ltd., 57 Assembly Drive, Tullamarine, VIC, 3043, Australia.
Phone: +61 3 9335 3333  Fax: +61 3 9338 9260  www.emctech.com.au

This document must not be copied or reproduced, except in full without the written permission of
the Manager, EMC Technologies Pty Ltd. The certificate on page 2 may be reproduced in full.
www.emctech.com.au
## Contacts

**Hawk Measurement Systems (Head Office)**

15-17 Maurice Court  
Nunawading VIC 3131  
Australia  
Phone: +61 3 9873 4750  
Fax: +61 3 9873 4538  
info@hawk.com.au

**Hawk Measurement**

7 River Street  
Middleton, MA 01949  
USA  
Phone +1 888 HAWKLEVEL (1-888-429-5538)  
Phone +1 978 304 3000  
Fax: +1 978 304 1462  
info@hawkmeasure.com

Global representatives on  
www.hawkmeasure.com

Represented by: